Report of the Halifax Harbour Cleanup Review Committee:

Assessment of Public Concerns and Possible Environmental Effects Related to the Regional Sewage Treatment Project

Nova Scotia

Halifax Harbour Cleanup Review Committee

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Dear Sirs/Madams:

The Halifax Harbour Cleanup Review Committee is pleased to present its report to you.

The Review Committee's objective was to provide an impartial third party review of the project, offer an opportunity for interested people to express their concerns and to determine if these concerns have been recognized and dealt with. Our recommendations, we believe, satisfy this objective.

The Committee's recommendations are based on consultations with various community and environmental groups, individuals and government officials.

The Review Committee held informational meetings in Halifax and Herring Cove and received both oral and written submissions. We found that there was great interest and concern regarding the proposal for a single regional sewage treatment plant for the Metro Halifax-Dartmouth area. The Committee was received with enthusiasm by the public and we feel that some sort of consultation process should be continued during the course of the project.

As a general recommendation, we feel that the resolution of the problems relating to the whole metro sewage treatment system proceed as quickly as possible, and that the final plant represent the best possible effort to meet the objective of cleaning up Halifax Harbour.

The Halifax Harbour Cleanup Review Committee unanimously recommends this Report and requests that you present it to the Minister of the Environment at the earliest opportunity.

Respectfully yours,

J. L. Harrison, Chairman

Harry Cook

Stephen Craig

Crosby McLeod

Michael McGill, P.Eng.

EXECUTIVE SUMMARY

The Halifax Harbour Cleanup Review Committee was established by the Nova Scotia Environmental Control Council in the early summer of 1988 to provide an impartial third party review of public concerns and possible environmental effects associated with the Metropolitan Area Planning Commission (MAPC) proposal for a regional primary sewage treatment plant at Sandwich Point. The proposal is intended to eliminate discharge of untreated sewage to Halifax Inlet within six years.

The Committee reviewed the available literature on Halifax Inlet and sewage treatment proposals spanning the last 18 years. It also received submissions on the proposed sewage treatment scheme from individuals and various interest groups. All the information was annotated to provide a synopsis of concerns about the project.

These concerns generally fell into four categories, related to the planning process, the design, construction, and operation of the regional sewage treatment plant.

The Review Committee was favourably received by the public, but there was some concern about its effectiveness. Because of the perception that the regional sewage treatment proposal is a political issue, sensitivity to public concerns is especially important and the recommendations of the Committee must be taken seriously if there is to be public confidence in the Committee's efforts. Public participation in the planning of the regional sewage treatment proposal has been inadequate. The public must be provided with more information on sewage treatment options for Halifax Inlet and must have some participation in the planning process.

It was observed that various tradeoffs in the design of the sewage treatment scheme, such as the limitation of sludge processing on the level of sewage treatment, need to be identified to ensure the optimal design for the most important objective of cleaning up Halifax Inlet. Oceanographic studies are required to allow proper outfall and plant site selection and there must be enough flexibility in the project schedule to accommodate them.

The various options for a single plant versus several plants, different locations, and levels of sewage treatment could not be properly assessed in the absence of water quality objectives. These in turn can only be developed after looking at our present use of Halifax Inlet and any sensitive areas which should be protected from the effects of a sewage treatment plant effluent.

The environmental effects of the effluent may include local accumulations of nutrients, fouling of fishing gear, and possibly, over the long-term, contamination of commercial fish and shellfish species if the residual effluent material contains hazardous wastes and if it settles in lobster and groundfish habitat. A better understanding of the composition of the sewage effluent and a prediction of the fate of the effluent

are required to properly assess these concerns. However, elimination of hazardous wastes from the sewage treatment system, treatment of storm overflow, and an outfall with a diffuser in deep water well away from susceptible resources or activities would go a long way towards minimizing any impacts associated with the effluent. In view of this, the Committee would like to see some consideration given to an outfall location beyond the mouth of Halifax Inlet.

Concerns about tunnelling included damage to property and wells and the possibility of acidic runoff from the tunnel material. Policies are required to deal with these construction concerns. Sludge from the treatment plant was also recognized as a waste problem which requires careful attention. The sludge processing should accommodate sludge which is currently generated at existing sewage treatment plants in Halifax County and also septage, if possible. The Review Committee also recognized the importance of comprehensive monitoring to measure the effectiveness of the plant and the achievement of water quality objectives.

The development of the regional sewage treatment proposal and the establishment of a funding arrangement for the project are clearly admirable. The Review Committee, in assessing public concerns about the project and the possible environmental effects, has put forward 30 recommendations which it feels will ensure that the regional sewage treatment scheme meets the objective of cleaning up Halifax Inlet to the satisfaction of all those who use the Inlet. In general, the Committee endorses the concept of eliminating sewage treatment plant effluents from the Inner Harbour and sensitive areas at the mouth of the Inlet. Regardless of the location of the sewage treatment plant(s) and the level of treatment, this may be achieved by consolidating the effluent(s) in an extended outfall which diffuses in deep water beyond the mouth of the Inlet.

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1.0 INTRODUCTION

1.1 THE PROBLEM

Approximately 44 million gallons per day of wastewater are produced by the population in the Halifax-Dartmouth metropolitan area. Of this amount, 38 million gallons, or over 86%, are discharged untreated from over 40 sewer outfalls into the waters of Halifax Inlet.

The aesthetic effects in Halifax Inlet are apparent as objectionable odours, accumulation of solids at outfall sites, unsightly algal growth, floating debris, low water transparency, and coloured effluent plumes.

As well, fecal coliform bacteria concentrations are elevated throughout the Inlet and together with nutrient enrichment of the waters, give rise to concerns regarding the health of the whole marine ecosystem. If we continue to discharge large quantities of raw sewage into Halifax Inlet, there will be further curtailment of the use of Inlet waters and beaches.

Over the last 20 years, numerous studies have been carried out related to the treatment of sewage from the Halifax-Dartmouth metropolitan areas. One of the main authoritative studies was that commissioned by the Metropolitan Area Planning Commission (MAPC), completed in August 1977. This study recommended a single regional sewage treatment plant at Sandwich Point at the western entrance to Halifax Harbour.

The Metropolitan Area Planning Commission later commissioned a 3-phase study, "The Halifax Inlet Water Quality Study", which was completed in May 1987. The study reaffirmed the Sandwich Point location.

After many meetings and discussions, the four municipalities of Halifax, Dartmouth, Bedford and Halifax County agreed in principle to the

project, with the proviso by resolution that:

"an environmental impact study be conducted into the effect of the outfall from the proposed Sandwich Point Treatment Plant on the Herring Cove fishery, and that the Department of the Environment be asked to determine the requirements for such a study".

On 20 April 1988, the acting Minister of the Environment, George Moody, replied to MAPC, stating: "I shall be instructing the Environmental Control Council to collect all reports and data pertinent to this proposal, solicit public comment, and provide me with a report on the environmental implications of sewage treatment at Sandwich Point".

1.2 APPOINTMENT OF THE REVIEW COMMITTEE

In May 1988, the N.S. Minister of the Environment wrote to the Chairman of the Environmental Control Council stating that: "I have concluded that the best resolution of this would be an independent assessment by the Environmental Control Council and request that you form a committee to do this".

The Chairman of the Council then appointed the following members to serve on the Halifax Harbour Cleanup Review Committee:

Harry Cook	Bridgewater
Stephen Craig	Lower Sackville
Michael McGill	Truro
Crosby (Bud) McLeod	Port Mouton
James Harrison	Dartmouth (Chairman)

Resource people for the Review Committee, provided by the N.S. Department of the Environment were: Frank Potter, Diane Coish and Lynn Brenton. In addition, John Carter of Martec Ltd. was engaged to provide support to the Committee in the areas of report review, assessment of relevant information from other sources, and report writing.

With these personnel in place, the Review Committee's work began, with the main mandate being to examine all aspects of the Sandwich Point regional sewage treatment project proposal and to make sure that all concerns have been identified and addressed, particularly with regard to the impact on the commercial fishery in the area.

The terms of reference of the Review Committee and its composition are shown in Appendices A and B.

2.0 OBJECTIVES AND METHODOLOGY

2.1 COMMITTEE OBJECTIVES

The N.S. Minister of the Environment concluded that the best resolution to concerns expressed regarding the Sandwich Point location for the regional sewage treatment plant was to form a representative committee to look at the technical information as well as the social and environmental factors.

The Review Committee was asked, in the Minister's words:

> "to review all existing information, interview persons knowledgeable of the project and the receiving environment, obtain and incorporate the concerns of individuals and groups potentially affected by the proposed plant and effluent discharge, and prepare a final report on the project impact. The report should consider the marine ecosystem impacts, commercial fishery related impacts, unknowns remaining and, if appropriate, recommendations for mitigation of adverse impacts identified".

In brief, the objective of the Committee was to provide an impartial third party review of the potential impacts of the proposal, with primary emphasis on the commercial fishery.

2.2 METHODOLOGY

The Halifax Harbour Cleanup Review Committee was established in the spring of 1988 and had its first meeting on 25 May. Throughout the summer, Committee members examined the large number of studies relating to Halifax Inlet and sewage treatment. As well, the Committee had discussions with personnel from the Metropolitan Area Planning Commission, Department of Municipal Affairs, Environmental Protection, Bedford Institute of Oceanography and the Department of Fisheries and Oceans. The bibliography for Halifax Inlet (see Appendix C) was annotated in the late summer.

The Review Committee placed advertisements (shown in Appendix D) in daily newspapers during September, advising of the formation of the Halifax Harbour Cleanup Review Committee and asking for either oral or written submissions from interested individuals and groups by 21 October 1988.

A short information package about the project was prepared and was available from the N.S. Department of the Environment offices in Halifax. This package, entitled "Project Proposal, Halifax Harbour Cleanup" is included as Appendix E.

A number of replies were received in response to the ads. Accordingly, meetings were arranged to hear submissions at a convenient central location in Halifax. The Review Committee also attended a meeting in the village of Herring Cove, jointly sponsored by the Committee and the Herring Cove Ratepayers Association, to hear concerns and comments from residents of that area.

It was stressed to the public that these meetings were not designed to "debate" issues, but were of an informational nature in order for the Committee to gather concerns, data, and comments regarding the sewage

treatment proposal. Presenters were questioned by Committee members when necessary to clarify points raised during the submissions.

A list of the meeting locations and dates is attached as Appendix F. A list of presenters is included as Appendix G.

The written submissions and the annotated bibliography are not included in this report because all the salient points have been included in the assessment in Section 4. However, they can be reviewed in the offices of the N.S. Department of the Environment.

3.0 BACKGROUND

3.1 THE PROPOSED REGIONAL SEWAGE TREATMENT SCHEME

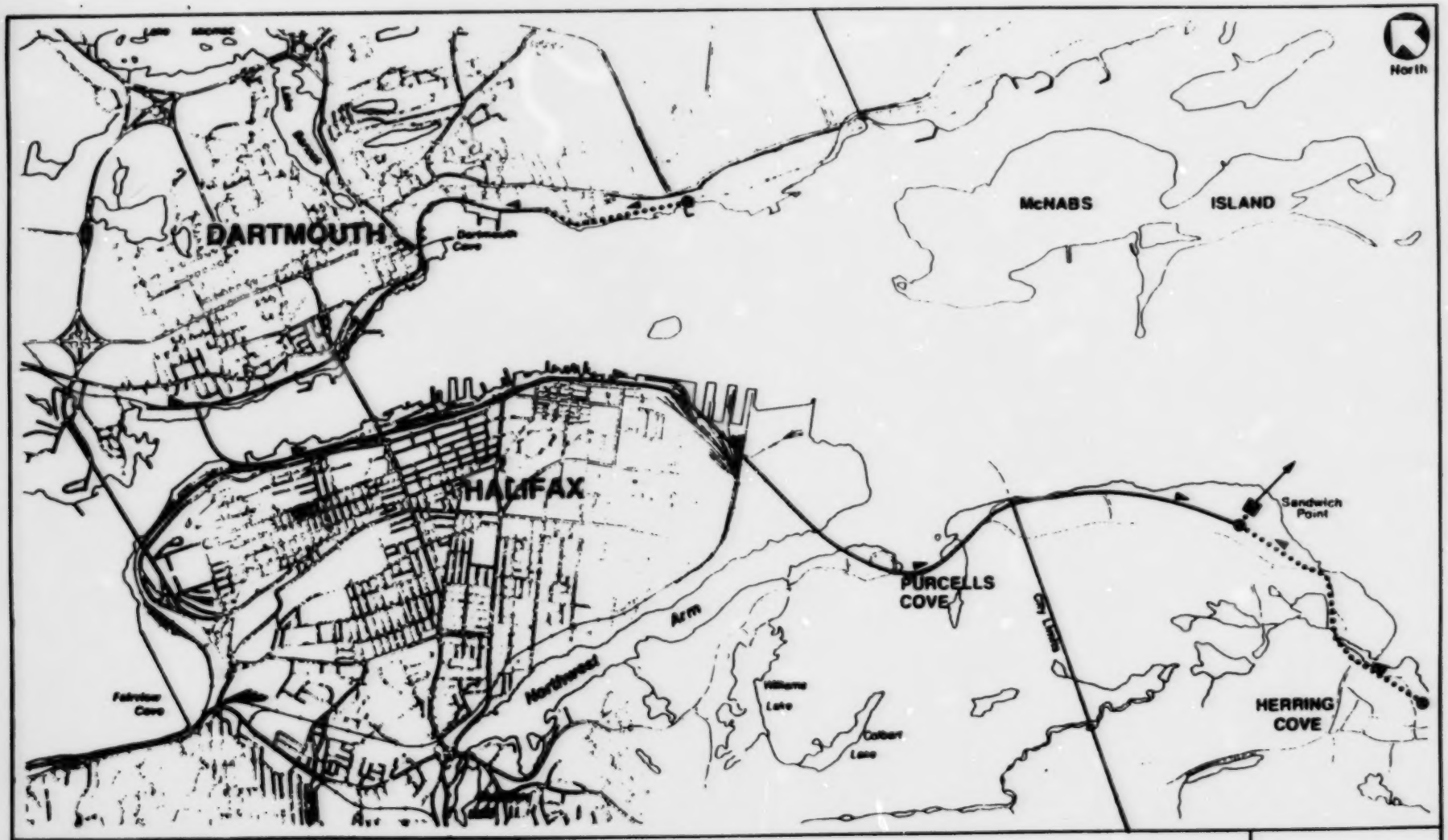
A summary of the regional sewage treatment proposal is provided in Appendix E. The main details of the proposal are outlined below. They are intended as a background to the public concerns and assessments by the Review Committee which comprise Section 4 of the report. More details on the regional sewage treatment proposal can be found in the CBCL (1987) report.

The regional sewage treatment proposal is the culmination of a significant effort over the last 15 years to effectively eliminate the aesthetic and environmental concerns associated with the discharge of raw sewage into Halifax Inlet. The most recent effort was a three-phase Inlet pollution control study which resulted in the 1987 CBCL report prepared for the Metropolitan Area Planning Commission (MAPC). The study, which included numerical modelling of biochemical oxygen demand (BOD) and fecal coliform bacteria (ASA Consulting Ltd., 1986), examined a number of sewage treatment strategies for the area, including a single treatment plant option and several multi-plant options.

The study concluded that the option involving construction of a single regional sewage treatment facility at Sandwich Point on the west side of the Outer Harbour offers the greatest potential for improvement in overall water quality in Halifax Inlet. Figure 3.1 shows the configuration of the preferred single sewage treatment plant option.

The proposed scenario would involve the following:

- construction of a piped interceptor system and pumping facilities to convey sewage from South Dartmouth to the beginning of an interceptor tunnel at Dartmouth Cove;



HALIFAX
HARBOUR CLEAN-UP PROGRAM
One Plant Scenario

FIGURE 3.1

- construction of an interceptor tunnel along the Dartmouth waterfront from Dartmouth Cove to Tufts Cove;

- construction of a tunnel under the Narrows from Tufts Cove to a point near the intersection of Duffus and Barrington Streets;

- construction of an interceptor tunnel from Duffus Street along the Halifax waterfront, across the Northwest Arm and through Purcell's Cove to Sandwich Point;

- construction of a pumping station and forcemain to convey sewage flows from the existing sewer outfall at Herring Cove to Sandwich Point;

- construction of a sewage pumping station and 40 million gallon per day capacity primary sewage treatment plant at Sandwich Point.

The treatment of the sewage would include a mechanically raked bar screen, an aerated grit chamber, clarification to settle and remove sludge, effluent disinfection with chlorine, and treatment and disposal of sludge. Options for the outfall include one in 18 m water depth, 140 m from shore and one in 35 m water depth, 500 m from shore. The expected reductions in pollutant levels are as follows:

- suspended solids	55%
- biochemical oxygen demand (BOD)	30%
- nitrogen	10%
- phosphorus	5%
- total coliforms	95%
- fecal coliforms	95%
- trace metals	25-50%

The sewage treatment plants at Eastern Passage and Mill Cove would still continue to operate.

The project is expected to have a number of environmental and economic benefits including improvement in the aesthetics and water quality within Halifax Inlet, reduction in the contamination of the seabed in the Harbour, reduced fouling of fishing nets, provision of jobs, increased tax revenues, decreased unemployment insurance and social assistance costs, increased tourism, and increased commercial and residential development activity.

The Federal and Provincial governments will each cover 37.5% of the cost. Halifax, Dartmouth, and Halifax County will share the remaining 25% of the cost. The six-year project will cost approximately $196 million.

4.0 PUBLIC CONCERNS, ASSESSMENT, AND CONCLUSIONS

4.1 INTRODUCTION

All concerns related to the regional sewage treatment proposal expressed by various interest groups and the general public were tabulated. They were then assigned to different categories as follows:

- concerns about the planning process;
- design considerations;
- construction concerns;
- operational concerns.

Many of the concerns were inter-related; that is, concerns about one aspect were dependent on details of some other aspect of the proposal. For example, in the minds of the public, the preferred degree of sewage treatment depended on the proposed location of the plant. Similarly, concerns for the fishery were obviously related to the proposed location of the outfall. This leads to some redundancy in describing the concerns, but this is necessary for the sake of properly assessing each concern.

In the following sections, each concern is described with specific points attributed to individuals or interest groups. The concern is then assessed by comparing it with the known details of the regional sewage treatment proposal and the literature on Halifax Inlet and sewage treatment in general. The Committee's conclusion about the validity and degree of concern is then presented.

4.2 CONCERNS ABOUT THE PLANNING PROCESS

4.2.1 Public Acceptance of the Review Committee

For the most part, the Review Committee was favourably received. This was evident from the number of presentations made to the Committee and their comprehensive nature. Because of past frustration with the lack of a public forum to discuss the proposed sewage treatment plant and a general lack of public information on sewage treatment, there was appreciation of a first opportunity to be heard (Herring Cove Ratepayers Association). However, the apparent legacy of unfulfilled promises concerning sewage treatment has made Herring Cove residents in particular distrustful and their appreciation of the Committee was qualified by a concern that the information gathered by the Committee will not be properly used (Ruffman) and that the Committee will have little or no influence over the planning process for the proposed regional sewage treatment scheme (Burke, Landry). Others were concerned about the Committee's inability to answer specific questions on the proposal and wondered if the Committee's report would be made available to the public (Ball). There was another concern that the review process appeared to be hurried (Ball, Ecology Action Centre).

The role of the Environmental Control Council in this particular proposal for regional sewage treatment was judged to be important as a "court of last resort" (Ruffman). However, it was expressed that the Committee's meetings should not be the final forum for concerned members of the public (Ecology Action Centre).

After assessing these concerns and examining the Herring Cove experiences in particular, it is very clear why there is both appreciation for the presence of the Committee and some wariness about the purpose of the Committee and how it may influence the proposed sewage treatment design. If the Committee is to be properly perceived as providing more than "lip

service", it must accurately record all public concerns about the regional sewage treatment proposal, determine which concerns require attention, and make appropriate recommendations to incorporate any necessary mitigation of concerns into the regional sewage treatment design. As far as the Committee is concerned, its mandate has been fulfilled. However, if the public is to have continuing confidence in the review process, it is important that the Committee's recommendations be implemented into the planning process for the regional sewage treatment scheme. As a final point, most of the presenters would like to see the Committee's work as the beginning of the public review process, rather than the end of the public input to planning.

In conclusion, there was a favourable response to the Committee, but concern about its effectiveness. There must be serious consideration of the Committee's recommendations in the design of the regional sewage treatment plant to maintain public confidence in such committees.

4.2.2 Access to Information

Many of the presenters suggested that not enough information concerning the regional sewage treatment proposal had been provided to the public (Ball, Belliveau, Ecology Action Centre, O'Brien, Power, Ruffman, Tremble). It was suggested that the information package that was provided should have been written in layman's terms and that information on conflicting issues should have been included (O'Brien). The Boston sewage treatment project was cited as an example of a good public information strategy (Ruffman). It was felt that reports dealing with Halifax Harbour and sewage treatment were difficult to obtain and that Government reports (such as those produced by Environment Canada) should be made public (Ecology Action Centre, Ruffman). It was further suggested that there seems to be a certain arrogance in thinking that the population cannot deal with reports and information (Ruffman). During the Herring Cove public meeting, there were many questions about the specifics of the

regional sewage treatment proposal, especially the exact site of the treatment plant. It was suggested that the Committee recommend to MAPC that the Commission should provide suitable information to any residents who may be affeced by the project proposal (Lichter).

The information package provided by the Review Committee was very general in describing the background to the project and focussed on the Halifax-Dartmouth perspective of the proposal. The main reason for this is that the project is only at the conceptual stage. Little information on the available options and how the final choice was made was provided in the package. The suggestion that not enough information was provided appears to be legitimate. However, it must be pointed out that most of the technical and engineering reports are publicly available at the N.S. Department of the Environment Library. Clearly, some of the presenters had reviewed at least some of these reports, but most members of the general public would not know of the existence of the reports or their availability.

In conclusion, if the public feels that not enough information has been provided and recognizing that most will not be able to review the technical reports, they must be provided with more details in layman's terms before final decisions on the project are made. This information should be provided by the project proponent.

4.2.3 Political Background as a Context for Public Perception

Past experiences in Herring Cove have lead to frustration with any discussion of sewage treatment proposals. It is important to document at least the general nature of this political background if the Herring Cove concerns are to be properly understood.

There appear to be two main threads to the Herring Cove concerns with regional sewage treatment. The first is a long-running debate with

the City of Halifax about the MacIntosh Run and the Tribune Head outfall. The second is the contention that the Herring Cove position on the regional sewage treatment proposal was misrepresented to MAPC. These two issues have led to a general feeling that Herring Cove has very little political power within MAPC and that the proposed Sandwich Point location for the sewage treatment plant is politically expedient for the Metropolitan area (Ball, Herring Cove Ratepayers Association). Several individuals at the public meeting in Herring Cove wondered if it was possible for County land to be expropriated for the sewage treatment plant, ignoring Halifax County concerns. There was also a general concern that the final project design will reflect political and economic decisions at the expense of social and environmental concerns.

In assessing the political "theme" behind public perceptions about the regional sewage treatment proposal, it is clear that the rough road in the past has angered Herring Cove residents and that unless all their concerns are addressed and mitigated, at least some residents will call political "foul play".

In conclusion, the regional sewage treatment proposal has been perceived as a political issue. Sensitivity to public concerns is extremely important if the final sewage treatment design is to be accepted as the correct socioeconomic and environmental decision.

4.2.4 Public Participation in the Planning Process

One of the most frequently cited concerns was that there has been no provision for public participation in the planning process for the regional sewage treatment proposal. The individual comments ranged from a need for public input to the design and location of the facility (Ball, Halifax County, Herring Cove Ratepayers Association) to a requirement for a full public hearing as part of the Environmental Assessment and Review Process (Buckley, Ecology Action Centre, Hanrahan, VanderZwaag, Zuk). It

was felt that the public should be involved in looking at all the options and selecting the correct one. It was also suggested that community representatives be part of the management team involved with designing and building the sewage treatment plant. Local people want to be part of the process (Pelham) and involved in the decisions (Belliveau). There should also be public discussion of the water quality objectives prior to selecting the degree of sewage treatment and the plant location (Ecology Action Centre). The example of Boston Harbour, in which there was public intervention in the proposed sewage treatment project, was cited (Ruffman). There was one suggestion that intervenor funding be provided to allow a public challenge to the proposed sewage treatment scheme (Vande-Zwaag). Finally, as noted previously, there was a fear that the information meetings and the public meeting in Herring Cove were the first and final chance for public participation in the planning process.

There is a question as to what happens once the Committee's report has been delivered to the Minister of the Environment. Only one presenter was concerned that implementation of the Environmental Assessment and Review Process would delay construction of the proposed plant (Dartmouth Chamber of Commerce).

The Review Committee feels that the concern about lack of public participation is legitimate. Although MAPC (Jackson, June, 1988) has said that the Commission wants to involve groups in the design process, the strategy to allow this has never been defined for the public.

In conclusion, public participation in the planning process for the proposed regional sewage treatment scheme has been inadequate. The public must be reassured that they will have an opportunity to be involved in the near future, before critical decisions are made, and should be provided with the format for public participation in the planning process. Delays due to public participation should not be an excuse for failing to involve the public.

4.2.5 Project Priorities: Technology Demonstration or Harbour Cleanup?

Only one presenter questioned the priorities in the proposed plan which involves conversion of the sludge to oil. There was a question as to whether the project was intended as a demonstration of the sludge-to-oil technology, with harbour cleanup as a spinoff, or whether the project was truly designed to clean the harbour in the best possible way (Ecology Action Centre). It was suggested by the Ecology Action Centre that if technology demonstration is the main priority of the project, the clean-up aspect may be compromised in some way. For example, the sludge-to-oil technology works best with sludge from primary treatment. This excludes any cleanup benefits associated with more extensive treatment (e.g., secondary). It was stated that the technology should be appropriate for the most important job of cleanup.

There is some truth to this concern. All elements of the proposal should be directed to the best possible cleanup of the Harbour and adjacent water. If one element of the proposal compromises the effectiveness of another, the tradeoff in terms of harbour cleanup should be clearly defined, so that decisions on the final design do not lose sight of the ultimate objective of the project.

4.2.6 Project Management

The category of project management is a catchall for some of the less specific concerns about the planning process, management structure, scheduling, and operational decisions.

In general, it was not clear to the public what the management structure for the sewage treatment scheme is and how it reflects regional interests. It was suggested that a management committee comprising regional representatives be set up to oversee the design and construction

of the proposed sewage treatment plant (Ruffman). It was also suggested that the system could perhaps be operated by a private company (Ruffman).

There were concerns that the planning process does not include social and environmental parameters and that there is too much emphasis on economic and engineering factors (O'Brien). In view of this, it was suggested that enough time be allowed for proper studies of the social and environmental issues (O'Brien, Ruffman). These studies could take at least one year (Ruffman). The required oceanographic studies could take several years (Fisheries and Oceans). Additional studies may be required to allay the fears of the public. There were other scheduling concerns. As noted previously, one presenter was concerned that initiation of the Environmental Assessment and Review Process could delay the project (Dartmouth Chamber of Commerce). The diversion of the present outfall at Tribune Head and construction of the new outfall should be carried out during the initial construction phase (Halifax County).

There were several concerns about the actual operation of the plant. One presenter wondered if there is an allowance for future expansion of the plant (King). Others wondered what contingencies there were for power outages or plant breakdowns (Christian-Ruffman, Ruffman).

These concerns are difficult to put together in one category, but they do have one theme. The lack of detail in the information package on the management of the regional sewage treatment scheme has led to concerns about the management structure, scheduling, and mechanisms for decision-making. It is the Committee's understanding that project management is presently being assessed. Many of the concerns noted above may be addressed once the project management is put in place. However, the public may want a part to play in the management structure for the project, before it is finalized, so that there is public influence over the types of studies required to deal with regional concerns and environmental issues.

There are two obvious public positions on the matter of scheduling. On the one hand are those who want the earliest possible construction of the regional sewage treatment plant (having decided that the current proposal is fine). On the other hand are those who are uncomfortable with the proposal and do not want to rush into what they think is not the best choice. Several presenters felt that the project should be "done right the first time". They caution that a sufficient time should be allocated for all the studies that are required. As will become evident later in this report, additional studies are required and the scheduling must accommodate them.

In conclusion, in order to encourage public contribution to the project, the management structure should properly reflect regional and various sector interests. There should also be enough flexibility in the schedule for proper planning and additional studies. Urgency for time should not be the sole criterion for setting the schedule.

4.2.7 Objectives for Halifax Inlet Water Use

One of the most significant concerns about the planning process is a lack of guidelines on water quality and water use within Halifax Inlet and adjacent waters. Since 1970, when regional sewage treatment was first seriously considered, all the engineering and technical studies have examined sewage treatment options in the absence of any water quality objectives, beyond the very general one of improving the water quality. Most of the project consultants have stated the requirement for establishing water quality objectives (H.J. Porter, 1977; ASA Consulting Ltd., 1986; CBCL, 1987). The main point is that a regional sewage treatment scheme cannot be properly developed without prior knowledge of water quality requirements in each region of Halifax Inlet and adjacent waters.

Many of the presenters dealt with this issue as well (Dartmouth Chamber of Commerce, Ecology Action Centre, Northwest Arm Heritage Assoc-

iation, O'Brien, Ruffman, VanderZwaag). It was stated that water quality guidelines should consider the commercial fishery, tourism, recreation, aesthetic value, habitat for marine life, and transportation (Ecology Action Centre). The water quality objectives should be determined with proper public input, prior to a consideration of the sewage treatment options (Ecology Action Centre, VanderZwaag). Future uses of the harbour should also be considered (Ecology Action Centre). In this regard, competing objectives (such as swimming and shipping) should be properly assessed.

There were specific concerns about the quality of the Northwest Arm. It was hoped that minor sewage problems in the Arm at the moment (perhaps from forgotten sewer pipes) can be eliminated and the whole of the Arm made safe for swimming, shellfish harvesting, commercial and recreational fishing (Northwest Arm Heritage Association). Many of the presenters wanted to maintain swimming (with no health risks) in the traditional swimming areas and maintain (or enhance) the commercial fishery. There was also one suggestion that marine sediment quality objectives also be established, following the example of Great Lakes jurisdictions (OceanChem Group).

Lack of objectives for Halifax Inlet water use is a serious problem. The design of the proposed regional sewage treatment scheme (including the level of treatment) cannot proceed properly without knowing what it must achieve. As a first step, one must accurately map all the existing activities and sensitivities in the Inlet and adjacent waters. The public should have input to decisions as to whether the activities are to be maintained or enhanced and if protection is required for sensitive areas. Out of such an exercise would come a detailed constraint map which should be used to design and locate the plant and outfall (assuming knowledge of the plant effluent and behaviour of the effluent in the receiving water).

This logical approach to coastal water quality management, involving the public and all levels of government, is necessary if there is to be consistent and effective decision-making. This approach is increasingly being incorporated into water quality management in the United States (Robinson and Horzepa, 1988). Such an approach should be considered for the current regional sewage treatment proposal.

In conclusion, it appears that the regional sewage treatment proposal has been developed without an accepted definition of water quality objectives. This raises the question: is the proposed sewage treatment plant the best option to meet a general consensus on what the Harbour and adjacent waters should be used for?

4.3 DESIGN CONSIDERATIONS

4.3.1 The Single Plant Versus the Multi-plant Option

The CBCL report of 1987 examined a number of sewage treatment options ranging from a single regional sewage treatment plant at Sandwich Point to six plants scattered around the Metropolitan area and Herring Cove. The main focus was on a comparison of one plant versus three plants. Engineering and economic criteria were the main considerations, but there was also a consideration of biochemical oxygen demand (BOD) and coliform bacteria levels, based on the ASA Consulting Ltd. model. The modelling results indicated that the regional plant at Sandwich Point with primary treatment has the greatest potential for overall water quality improvement (within the confines of the model). A main consideration in this case was minimizing the nutrient input to Bedford Basin.

As indicated earlier, because the planning process did not include a detailed assessment of social and environmental issues with public input, the public has questioned the decision to construct a single plant and has criticized the way in which the decision was reached.

Those who endorse the single plant option include MAPC and the Dartmouth Chamber of Commerce. Environment Canada has said the three-plant option would be acceptable, but they favour the single regional sewage treatment plant proposal. Many presenters wanted proof that the single plant option is better, taking all issues into consideration, and generally favoured the three-plant option. It was reiterated that the wishes of Herring Cove (supporting the three-plant option) were misrepresented to MAPC. It was suggested that there should be more study of the options (Belliveau, Halifax County).

A number of arguments were advanced for the multi-plant option. It was stated that it is unwise to dispose of all the sewage effluent at one

location. Sewage should be the responsibility of each municipality (Ball, Pelham, Tremble). Herring Cove residents are willing to have a sewage treatment plant (with at least secondary treatment) at Tribune Head, but would like to have Dartmouth and Halifax handle their own sewage.

It was suggested that the multi-plant option would be better because there would be local pressure to have plants operate properly and there would be reduced construction costs because of less tunnelling with the use of existing collection lines (Ruffman, Willison). It was mentioned that the multi-plant option may have higher operating costs than the single plant, but that the excess cost could be met within the tax base and there would be additional jobs provided by the larger number of plants (Belliveau).

The arguments for the various options revolve around two main points: odours from the plant being offensive, and effluent from the outfall affecting local water quality. It was perceived by the Committee that water quality concerns were more important than the concern for plant odour. It was noted by the Committee that plant odours can be controlled by covers, vents, and scrubbing to the point that the concern for odours can be reduced, no matter where the plant or plants are located. In the second case, it was observed by the Committee that most presenters equated the outfall location with the plant. However, because longer outfalls have now been considered by MAPC, it must be assumed that the outfall location can be considered independent from the plant location, if necessary, especially if there are no serious financial constraints in building a longer outfall.

These arguments all come back to a need to establish water quality and water use objectives for all of the harbour and adjacent waters. Without these objectives, citizens west of Purcell's Cove will always argue against a plant in their neighbourhood (the single plant option)

which could reduce their marine water quality and residents in the Metropolitan area could argue against sewage effluent (even though treated) along their waterfront (the multi-plant option). At the moment, the solution for one group is at the expense of another group.

In conclusion, from purely the engineering and economic points of view, there does not appear to be a clear case for either the single plant or multi-plant options. An initial modelling assessment of BOD and coliform bacteria and assumptions about nutrient loading to Bedford Basin lend some support to the single plant option (with discharge as far away as possible from the Narrows). However, people living near the proposed location of the single plant feel that there is not enough information on the fate of the plant effluent to convince them that their marine waters will not be further degraded. They reject the single plant option (with a short outfall) on these grounds. Unfortunately, one cannot assure these people that the effluent from the plant will not affect them. It is therefore necessary to conduct more detailed studies of the possible fate of the plant effluent and perhaps consider an option for a longer outfall which will ensure that there is no further degradation of coastal waters near Halifax and Herring Cove.

4.3.2 Regional Plant Location

Concerns about a single regional sewage treatment plant location are naturally related to those described in the previous section. For present purposes, the assumption is made that a single regional plant is the only option and the concern therefore is where it should be located. Again, as noted previously, there has been a general equation of the outfall with the treatment plant, when in fact the two can be separated if necessary. Therefore, most of the concerns relate to the effect of the effluent from the outfall.

Site selection for a single regional sewage treatment plant began as early as 1970 (MacLaren Atlantic Limited, 1970). At this time, sites within the harbour were rejected for a variety of reasons. Hartlen Point was rejected because of the high overall construction costs and the presumed current flow southwest past the Point and into the harbour. A location on the south side of Purcell's Cove was suggested, but was later rejected by Halifax City Council. The 1977 MAPC report (H.J. Porter, 1977) recommended the Sandwich Point site, although it was pointed out that extensive excavating and infilling would be required. Since then, the Sandwich Point site has remained the favoured MAPC option for a regional plant (CBCL, 1987), although there have been some recent comparisons made between oceanographic conditions at Hartlen Point and those at Sandwich Point (ASA Consulting Ltd., 1988).

There was much discussion of the proposed regional plant location. It was stated that if the decision for the single plant option is firm, there should be detailed assessment with public input of the alternative sites for the single plant (O'Brien). Herring Cove residents fear that the decision for a single plant at Sandwich Point is politically expedient (Tremble), because there would be less public opposition to the Sandwich Point site than to other sites closer to the Metropolitan area. Herring Cove residents wanted to know the exact proposed location for the plant, whether it would be on the high ground between the National Defence facility and the shore, or in the low-lying area near East Pine Island Pond. They expressed concern for the appearance of the plant, odours from the plant, and possible damage to wells caused by blasting. Some presenters felt that the Sandwich Point location was inappropriate next to a park and that it would destroy the aesthetic value of that part of the shore for people in pleasure craft (Northwest Arm Heritage Association). There was concern that land availability at the Sandwich Point site has never been discussed with the Department of National Defence (Power, Ruffman). One presenter wondered whether future growth of the Metropolitan area had been considered in selecting the site (Ecology

Action Centre). Some thought that the site had been picked without enough information to properly decide and one presenter felt that seismic surveys were required to properly define the tunnelling aspect of the project and therefore the final site for the plant (Ruffman).

Almost all those who rejected the Sandwich Point site suggested Hartlen Point as a site for the plant. One suggested Chebucto Head (Baker). It was suggested that the Hartlen Point site had been rejected too hastily (Ruffman). The main support for a plant at Hartlen Point was the closer proximity to open ocean, although studies by ASA Consulting Ltd. (1988) indicate that a 4,400 m long outfall would be required at Hartlen Point to provide the same dilution provided by a 500 m long outfall at Sandwich Point and there would be only minimal elevation (static head) at Hartlen Point which could lead to poorer dilution. Proponents of the Hartlen Point site suggest that the shoals off the Point would prevent entry of the effluent plume into the Harbour, despite the hypothesized sweep of the Nova Scotia current into the harbour.

It was suggested that the Shearwater Golf Course and the old artillery training site would serve as suitable buffers between a Hartlen Point plant and residences. One presenter suggested that such a site would serve rapidly developing areas near Cole Harbour (Northwest Arm Heritage Association). Although additional sewage connectors would be required to reach a Hartlen Point plant, it was suggested that tunnelling through glacial till would be cheaper than tunnelling through solid rock. Available data indicate thickness of till ranging from less than one metre to 13 metres. Although not mentioned by any of the presenters, anticipated sea level rise due to global warming over the next 100 years could be a concern at Hartlen Point.

An assessment of the literature and careful attention to the information presented during the meetings suggest that the Sandwich Point site has remained as the only single plant site which has been seriously

considered since 1970, when Purcell's Cove, Hartlen Point, and other sites in the Harbour were rejected for a variety of reasons. From study of the various reports, the Review Committee feels that the reasons for rejection of sites other than Sandwich Point were not adequately explained and, therefore, it is difficult to defend the decision for Sandwich Point when challenged. Those who oppose Sandwich Point have proposed their own sites, but they, like the proponent, have not comprehensively assessed the various options. The Committee cannot decide on the suitability of any site without more specific information which may affect engineering design and costs. It is possible that a requirement for a longer outfall will have to be one of the criteria for selecting a site. What may be an optimal site in terms of tunnelling and other construction considerations may not be optimal if a long outfall is required.

In conclusion, the Sandwich Point site can be neither defended nor rejected until it has been adequately compared to other sites which may offer at least the same or more improvement in Halifax Inlet. The comparison should include the cost of various outfall lengths, since the outfall location is the ultimate concern in comparing one site to another. Whichever site is picked, there should be assurance that water quality objectives for the whole area of interest can be met.

4.3.3 Degree of Sewage Treatment

There was considerable discussion by presenters on the degree of sewage treatment required to effectively reduce water quality problems in Halifax Inlet and to prevent new water quality problems at the outfall. It must be pointed out that almost every individual who commented on the degree of sewage treatment did not present any information on the expected effluent quality or make an objective comparison between the different levels of treatment. Many of the comments on degree of sewage treatment were specific to one or more plant locations (not necessarily

the Sandwich Point site). It is the Review Committee's opinion that there was a general lack of knowledge of sewage treatment processes, making it difficult for individuals to make a clear case for one level of treatment or another. Most of the presenters insisted on at least secondary treatment of sewage. The current proposal is for primary treatment of sewage, with a contingency for a higher degree of treatment if required in the future. The public concerns about the degree of sewage treatment are reviewed below.

It was suggested that primary treatment is better than nothing, although it was recognized that secondary treatment could be better and should be examined as a future requirement (Dartmouth Chamber of Commerce, OceanChem Group). Most of the presenters were concerned that very little attention had been given to any sewage treatment beyond the primary level. It was suggested that primary treatment has been the focus in the proposal because it is cheaper than higher levels of treatment and other concerns have not been taken into consideration (Ruffman). Another presenter insisted that the project be done correctly from the start and that secondary and tertiary treatment be seriously considered (Ball).

On the other hand, several individuals and groups felt that primary treatment is probably adequate at this time for Halifax Inlet (Environment Canada, Lawrence), as there is apparently no evidence to suggest that greater than primary treatment is needed. It was, however, stated that there should be a contingency to add higher levels of treatment in the future.

Most of those who proposed a secondary level of treatment supported the multi-plant option. They suggested that there would be a reduced expenditure on tunnelling with plants located in the Metropolitan area and that these funds could then be spent on a higher level of treatment (Herring Cove Ratepayers Association, Ruffman, Willison). Some even

suggested one tertiary plant at the centre of the existing collector system. Herring Cove residents are aware that up to 55% of the suspended solids can be removed with primary treatment. They feel that the remaining 45% in an effluent volume 10 times greater than they receive now will be damaging to the fishery and therefore unacceptable. The fishermen feel that effluent from a secondary treatment plant in their area would reduce the problem they are now having with fouling of nets. A few of those who supported the secondary level of treatment said that if the final option is a single regional plant with primary treatment, the effluent must go into the open ocean, not in an area off Sandwich Point (Northwest Arm Heritage Association, Ruffman).

One presenter suggested that not enough is known of the sewage quantity and composition and that this must be determined now and forecast for the future in order to design sewage treatment that reduces or minimizes the harmful nature of the waste. The example of Boston Harbour was cited (Ecology Action Centre). It was stated that sewage treatment will not remove the dissolved chemical contaminants (Buckley). The most effective solution to toxic materials in the sewage effluent is to prevent their entry at source. A less desirable alternative is to ensure enough dilution of effluent at the outfall to reduce the toxic chemicals to background levels as close as possible to the outfall.

A review of the literature on the proposed sewage treatment for Halifax Inlet indicates that since 1977 no level of treatment greater than primary has been seriously considered as an option for a regional sewage treatment scheme. The rationale has included the idea that secondary treatment should not be necessary for sewage entering the ocean, since the sea should be capable of assimilating all but the toxic substances (H.J. Porter, 1977). It was also suggested during these initial planning studies that the cost of extracting nutrients (partial extraction is possible with tertiary treatment) is probably unjustified by the benefits. The assumption in this case is that the nutrients

entering the sea can be beneficial to fisheries. It was also suggested that extensive tertiary treatment could create an extensive sludge disposal problem. It is interesting to also consider that earlier work (1971) resulted in secondary, not primary, treatment plants discharging into Mill Cove and Eastern Passage. One could have assumed that this sets a precedent for sewage effluent discharge into the Harbour, with anything less than secondary treatment being unacceptable. In fact, the Eastern Passage plant has been changed to primary treatment to handle a larger volume of sewage. This indicates that primary level effluent in the Harbour may be acceptable to some.

The issue of degree of sewage treatment is very complicated, because a number of other issues have to be resolved at the same time. These include:

- the maximum acceptable cost of the project;
- whetner the proposal is for one plant or more than one plant;
- the location of the outfall;
- the definition of water quality objectives;
- a better definition of the quantity and composition of sewage;
- the treatment of toxic compounds at source;
- the restrictions of the oil-from-sludge technology;
- the possibility of treating storm overflows (greater than 4 times average dry weather flow).

Obviously, MAPC considers that these issues have been resolved in favour of a primary treatment plant at Sandwich Point with a 500 metre outfall. However, it appears that the public challenge to this option is justified, because the arguments for the various options have not been brought forward and adequately assessed in the eyes of the public.

In unravelling some of these issues, it should be helpful to briefly consider the various levels of sewage treatment. Primary treatment

includes screening, grit extraction, primary clarification, and chlorination of the effluent. The expected removal efficiencies, as stated in the proposal, are:

suspended solids	- 55%
biochemical oxygen demand	- 30%
nitrogen	- 10%
phosphorus	- 5%
total coliform bacteria	- 95%
fecal coliform bacteria	- 95%
trace metals	- 25-50%

As can be seen, there is still a considerable quantity of solids, BOD, nutrients, and metals in the effluent, which can be a concern, depending on the nature of the receiving water and the expected water quality objectives. Secondary treatment involves the elements listed above, as well as biological oxidation (for example, trickling filters). This treatment level results in a further reduction in suspended solids and BOD, but also produces a higher volume of sludge which is more difficult to handle than that from primary treatment. Secondary treatment would be considered for receiving waters which should not undergo even marginal oxygen depletion. Tertiary treatment includes additional steps which remove more of the nutrients, contaminants, and smaller particulate material. It is our understanding that tertiary treatment is considered for receiving waters which are subject to immediate re-use. It is not generally considered for marine waters. Tertiary treatment can result in a voluminous, sometimes toxic sludge. As pointed out earlier, none of the conventional treatment techniques is particularly effective in eliminating toxic compounds from the sewage effluent. Indeed, toxic materials in the sewage may cause severe disruption of the whole treatment process.

If there is a concern for additional nutrient loading in Bedford Basin, then any plants located in the Metropolitan area (the Narrows and Inner Harbour) would have to operate at a tertiary level. This could reduce nutrient levels in the effluent, but would not prevent toxic compounds from entering the Basin. A tertiary plant, requiring more land than a primary plant, might be difficult to locate in the Metropolitan area. If these were considered prohibitive problems, a more remote plant with a lower level of treatment is an alternative. Whether it operates at the primary or secondary level depends on the ultimate location of the outfall and the intended water quality within the zone of influence of the outfall. If it is considered satisfactory to operate at the primary level, then the outfall location becomes more critical. It would be essential to minimize nutrient accumulation and transport of suspended solids and toxic compounds back into Halifax Inlet.

In conclusion, it is the Review Committee's opinion that the sewage treatment proposal does not include a comprehensive enough comparison of the various levels of sewage treatment, in combination with various plant and outfall locations (including an option of one long outfall with preliminary sewage treatment). It would be very useful if the cost and removal efficiencies of each of the levels of treatment were compared, so that the additional cost of removal increments can be brought into the decision-making for the plant. In the absence of a convincing case for primary sewage treatment at Sandwich Point, various presenters have suggested their own options, without presenting any better case than MAPC. It is clear to the Review Committee that detailed listing of constraints (mapping of activities and sensitivities) must be completed and water quality objectives set before outfall locations and various degrees of sewage treatment can be properly determined.

4.3.4 Oceanographic Conditions in Halifax Inlet

A frequent observation was that the knowledge of oceanographic conditions in Halifax Inlet and adjacent waters is inadequate for the proper selection of a treatment plant and outfall (Ball, Belliveau, Dartmouth Chamber of Commerce, Ecology Action Centre, Environment Canada, Herring Cove Ratepayers Association, Lawrence, OceanChem Group, Pelham, Power, Ruffman). There are current meter records for Bedford Basin, the Narrows, and a point outside the Harbour, but these records do not provide any information on circulation at the proposed outfall site and do not provide calibration for the ASA Consulting Ltd. Halifax Harbour model (Ruffman). The resolution of the model is also too coarse to permit detailed prediction of localized currents at the outfall location (Hurlbut).

Drifter and dye studies (see Porter Dillon, 1986a for a review) and the observations of fishermen indicate a localized clockwise current (gyre) at Herring Cove, which may result in a movement of surface water towards Halifax. The relatively high frequency of winds from the west may also contribute to a surface movement towards McNabs Island. The limited information that is available indicates that there may be less than optimal drift conditions for a surface effluent plume near Sandwich Point.

One of the reasons for the early rejection of the Hartlen Point site was the hypothesized sweep of the Nova Scotia current past Hartlen Point into the harbour. However, the presence of this circulation has never been confirmed and the site cannot be rejected for this reason alone. The requirement for oceanographic work for proper selection of the plant and outfall location has been recognized since 1970. However, this has never been filled. It probably should have been completed prior to work on the numerical model of the harbour. The modelling work itself probably should have been extended further towards the open ocean to accommo-

date more remote potential outfall sites and include the Nova Scotia current (Lawrence).

Although most of the comments on oceanography were concerned with circulation, there were several additional concerns about lack of knowledge of sediment parameters. It was suggested that seismic and side scan data must be collected for the harbour. There is a need to assess variability in sediment geochemistry and to relate this variability to sediment processes. A large number of sediment samples from the harbour have been collected. These are presently being analyzed for trace metal contaminants (Buckley). Future investigations should include determination of organic carbon and redox potential (oxidizing conditions in the sediments). There is also a need to document shoreline stability (related to storm surges and wave heights), coastal evolution of the outer harbour, and the effects of major stream outlets (Buckley). It was also suggested that it would be useful to assess the effects of temperature variation on benthic (bottom-dwelling) colonization and biochemical reactions (Hargrave). All of the studies suggested above reflect Fisheries and Oceans priorities in an attempt to better understand the dynamics of Halifax Harbour. The studies, if carried out by Fisheries and Oceans, would not necessarily focus on proposed sewage treatment, but some of the information could be useful in selection of the outfall location and monitoring of the effectiveness of the regional sewage treatment scheme.

Several additional, although more general, studies were suggested. These included examination of the water column fluxing of contaminants, evaluation of benthic fauna, fish, and fish habitat, and analysis of contaminants in the tissues of commercial fish and shellfish (Fisheries and Oceans). Fisheries and Oceans have conducted some studies of contaminants in lobster tissue from areas adjacent to the Tribune Head outfall, but these have not yet been published. One presenter was concerned that suspended material from the effluent would eventually settle out and come

back into the harbour (Ecology Action Centre). Oceanographic studies should include bottom as well as surface circulation.

In assessing the literature and the public concerns about the state of knowledge of oceanographic conditions in Halifax Inlet, it is clear that not enough is known about circulation and sediment conditions to pick the optimal location for a plant and outfall with any confidence.

In conclusion, the Review Committee feels that there must be comprehensive oceanographic studies carried out as soon as possible to determine the optimal location within Halifax Harbour and adjacent waters for a regional sewage treatment plant and outfall. The required studies should not just focus on the Sandwich Point site at the expense of a greater knowledge of circulation at the mouth of the harbour. The new oceanographic data should be used to refine and expand the numerical model of Halifax Inlet.

4.3.5 Location of Outfall

It was apparent to the Review Committee that most of the presenters equated the location of the outfall with the proposed location of the sewage treatment plant. This was probably due to the initial proposed outfall length of 140 metres. A later consideration of MAPC included a 500 metre long outfall at Sandwich Point (ASA Consulting Ltd., 1987). If one considers the option of a longer outfall, the plant location and the outfall location can then be considered separately.

Most of the presenters who were concerned about the outfall location were worried about degradation of water quality near the outfall and interference with the fishery. They preferred an outfall location in deeper water, further offshore, where there would be adequate dispersal of the effluent away from the areas of concern (Halifax County, Northwest Arm Heritage Association, VanderZwaag). Some of these presenters

suggested that an outfall from Hartlen Point might provide adequate effluent dispersal in the open ocean. Others suggested that if the level of treatment were higher, there would not be a requirement for an open ocean outfall, assuming that the treatment would be effective in removing any contaminants of concern. One presenter said that we need to know more about the dynamics of particulate matter transport at the outfall to properly assess whether return of contaminants along the seafloor is possible (Buckley). Another individual was concerned about aerosols being generated by the effluent plume at the surface during rough sea conditions (Power).

From an engineering point of view, the main concern is to obtain adequate initial dilution (50:1) at the outfall and ensure dispersal of the effluent plume away from the outfall location so that the water required for initial dilution is not already contaminated with effluent. Studies by ASA Consulting Ltd. (1987) indicate that double the design dilution can be achieved by placing the diffuser end of the outfall in 35 m water depth, 500 m from shore (at Sandwich Point). This apparently reduces by a factor of 4 an area in which dilution less than 130 times occurs. The remaining questions are whether the prediction is accurate, and what water quality and fisheries effects are associated with various dilutions of effluent from the outfall. These questions are very pertinent, as the proposed outfall, even at 500 m from shore, is within hundreds of metres of fishing grounds. Even with secondary treatment, the effluent would still contain chlorinated fresh water, organic carbon, nutrients, and any hazardous compounds introduced to the sewage system. It is obvious that the outfall location cannot be decided based on engineering considerations alone. The resource use activities adjacent to the outfall must be considered as well.

In conclusion, the outfall location has been constrained by the proposed location of the regional sewage plant at Sandwich Point and possibly a desire to keep the outfall cost at a minimum. The concern for

water quality and fisheries effects which started with the Tribune Head outfall has been perpetuated because the proposed outfall location is only about 2 km from the existing outfall and still very close to fishery berths and lobster grounds. Regardless of the level of treatment, the effluent from the plant will still be perceived to be noxious and therefore should be placed as far away as possible from areas that support resource use and recreational activities. If one assumes that an outfall does not have to be adjacent to the sewage treatment plant, the logical approach to selection of an outfall location is to develop a sensitivity or constraint map for the harbour and adjacent waters, establish a knowledge of circulation (including the wind-driven component) in the study area, develop objectives for water quality and use, and then pick a number of outfall location options. It would be useful to include at least one option for an outfall 10 km offshore in 45 m water depth, for the sake of cost-benefit analysis. Perhaps it would be useful to consider the best outfall location prior to a final decision on the location of the regional sewage treatment plant(s).

4.3.6 Examples from Other Jurisdictions

A few of the presenters were concerned that the regional sewage treatment proposal has not made effective use of experience from other jurisdictions (Dartmouth Chamber of Commerce, Gordon, Pelham, Ruffman). The most frequent reference was to the current Boston Harbour sewage treatment project, in which $6.1 billion is slated for primary and secondary treatment of 1.2 billion gallons of sewage per day, with sludge handling, and effluent discharge about 16 km offshore. The Boston system will include control of raw sewage discharges from 88 combined sewer overflows. Other presenters cited examples of sewage treatment in Ontario and sludge processing in Florida (Gordon, Pelham).

The main idea in referring to the Boston example is that it was felt that the installation of primary sewage treatment 18 years ago was a mistake. The presenters were concerned that a similar mistake could be made with the current regional sewage treatment scheme. They suggested that the Boston example be carefully examined and perhaps some technology transfer be initiated.

A review of the literature on Halifax Inlet sewage treatment schemes does indicate little consideration of sewage treatment in other jurisdictions. However, one of the reasons for this may be that it is difficult to find situations similar to Halifax Inlet. Unless there are similarities in sewage quantity and composition, shoreline configuration, and physical oceanographic conditions, the comparison between Halifax and other jurisdictions is not very informative. Although a few presenters suggested that Boston Harbour is sufficiently similar to Halifax to warrant attention, the Review Committee feels that configuration of Boston Harbour, oceanographic conditions, and past sewage handling practices are probably not very similar to such parameters in Halifax. Similarly, conditions in Ontario and Florida are not similar to those in Halifax Harbour, and useful comparisons cannot be made. However, the Review Committee does not want to dismiss examples from other jurisdictions altogether. It is possible that there are some situations similar to Halifax Inlet which would be worthwhile to examine, from a sewage treatment design perspective. A considerable effort would be required to find these examples from other jurisdictions.

In conclusion, the Review Committee observes that there is little discussion of sewage treatment in other jurisdictions in the literature on Halifax Harbour regional sewage treatment. The examples cited by several presenters are not analogous and therefore have limited use in designing the system. However, it would perhaps be useful to examine the Boston sewage project from a planning point of view, to determine how the design evolved and how the public concerns were accommodated. It is also

suggested that some effort should go into finding several examples similar to Halifax Inlet in which regional sewage treatment has been implemented and monitored.

4.4 CONSTRUCTION CONCERNS

4.4.1 Effects of Tunnel Construction

The main concern with tunnel construction was the potential for damage to wells and subsequent loss of water (Ball, Belliveau, Gordon, Herring Cove Ratepayers Association, Ruffman, Tremble). It was noted that there was disruption of wells during construction of the high school in Herring Cove (Belliveau), so there is a real precedent for this concern. It was suggested that the cost of providing water to those who suffer well damage in Purcell's Cove, Ferguson's Cove, and Herring Cove could reach $20 million, but this figure was not supported with any facts (Herring Cove Ratepayers Association). Another presenter was concerned that blasting for the tunnels may damage foundations and plaster (Zuk). It was suggested by another that blasting could cause leakage of septage into the water supply (Belliveau). There was some concern for the effects of construction on the habitat and wildlife in the Northwest Arm (Northwest Arm Heritage Association).

Several presenters were concerned about where the material from tunnel excavation would go, as it is possible that the Halifax slate encountered during tunnelling could result in low pH and high iron concentrations in runoff from the tunnel material (Zuk).

MAPC stated that since the engineering design for the Sandwich Point proposal has not been done, the effects on wells from tunnelling and excavation for pipes are not known (Jackson, June, 1988). It was pointed out (Murphy) that a pre-blast survey would be conducted and there would be an attempt to use present easements and minimize crossing private property.

Some guidance on the potential problem of water supply disruption is provided by the Nova Scotia Department of Transport policy for investi-

gating and documenting wells that could be affected by highway construction. The policy requires a survey of all wells and water analysis prior to construction. Property owners are informed of any impending construction. In the event of well disruption, no more than three months can be taken to rehabilitate the well. Water must be provided during this time. There is a provision to bring in the expertise of the Nova Scotia Department of the Environment if necessary.

Our assessment of the effects of blasting and tunnelling is that the concerns are legitimate. If the previous record of well disruption in Herring Cove is correct, there is potential for well disruption during blasting and tunnelling for the regional sewage treatment plant. Material from tunnelling needs to be assessed geologically to determine its potential to cause acidic runoff. Disruption of wildlife in and near the Northwest Arm can be minimized by proper construction scheduling to avoid sensitive seasons for wildlife.

In conclusion, tunnelling may cause damage to wells in the area between Purcell's Cove and Herring Cove. Proper surveys must be carried out prior to construction if the Sandwich Point site is selected. A policy for assessing well damage, provision of water in the event of disruption, and fair compensation must be developed with public input prior to final site selection, so that the potential cost of repairing wells and/or providing alternative sources of water can be assessed. A policy must also be developed for handling the material from tunnelling.

4.5 OPERATIONAL CONCERNS

4.5.1 The Effect of Leaking Collector Tunnels on Groundwater

Two presenters were concerned about the possibility of the collector tunnels leaking and contaminating groundwater (Gordon, Lapierre). Another presenter suggested that repair of the tunnels, if necessary, would be very difficult (Power).

Although it was stated by MAPC that the tunnels would be lined, it is impossible to assess the possibility of leaking without obtaining more data on ground movement in the area, bedrock conditions, tunnelling methods, and the nature of tunnel lining.

In conclusion, tunnel leaking may be a concern for those who rely on groundwater for their water supply. The concern cannot be properly assessed without more detailed study of the issue. The engineering design should consider the potential problem of tunnel leaking.

4.5.2 Hazardous Wastes

There was a fairly high level of concern for hazardous wastes which may enter the sewage system and which may not be removed from sewage during treatment. Previous studies (Porter Dillon, 1986c) indicated that 22,800 tonnes of industrial or institutional waste are produced annually and that 4,056 tonnes are inappropriately disposed of. Twenty-two percent of this waste apparently goes into the sewer system. There was concern that contaminants from hazardous wastes tend to associate with suspended particulate matter and that these will deposit on the seabed and lead to contamination of commercial fish and shellfish (Buckley, Ecology Action Centre, OceanChem Group). One presenter felt that damage to foliage at the Tribune Head outfall several years ago was caused by a hazardous chemical dumped into the sewer system (Ball).

Almost all the presenters who were concerned about hazardous wastes suggested that these wastes need to be treated at source (Dartmouth Chamber of Commerce, Ecology Action Centre, Northwest Arm Heritage Association). Two presenters suggested that a transfer station be built to handle hazardous wastes from domestic and small industrial sources (Dartmouth Chamber of Commerce, Ecology Action Centre). It was suggested that municipal by-laws dealing with hazardous wastes be adopted and enforced (Environment Canada, Ecology Action Centre, CBCL, 1987). Public education on the serious matter of hazardous wastes was encouraged (Ecology Action Centre). Previous reports reiterated the need for a proper analysis of sewage samples to determine the current load of toxic contaminants in the sewage (H.J. Porter, 1977). Early analysis indicated trace amounts of phenols and cyanides and fairly high levels of oil and grease (Applied Marine Research Ltd., 1976). Unless such contaminants can be removed at the source, the only effective treatment is to ensure rapid dilution and transport of the effluent away from sensitive areas. It should also be pointed out that some hazardous wastes can severely disrupt the sewage treatment system.

In conclusion, the concern for hazardous wastes in the sewage system is legitimate, considering that industrial waste is currently dumped into the harbour via the sewage system and that even high levels of sewage treatment are ineffective in removing some of the more soluble toxic compounds. A high dilution rate could be considered as some form of accommodation of the hazardous waste, but the Review Committee feels that it is unwise to spend $200 million on a sewage treatment scheme and have the benefits of the scheme compromised by poor hazardous waste control. Hazardous wastes should be eliminated from the sewage system as much as possible. This can be accomplished by public education and enforcement of comprehensive municipal by-laws, as recommended by the Minister's Task Force on Hazardous Waste Management.

4.5.3 Storm Overflows

The proposed allowance for stormwater in the sewage treatment system is four times the average dry weather flow. It is assumed that any flow in excess of this will be discharged without treatment. Earlier studies indicated that overflows occur about 2% of the time and account for about 3% of the annual fecal coliform load (CBCL, 1987). Most of the overflows will occur during heavy rains in the spring and fall. Despite an improvement in average BOD and coliform levels in Halifax Inlet expected with a regional sewage treatment scheme, the storm overflows will cause almost immediate increases in coliform levels in areas normally not contaminated (ASA Consulting Ltd., 1986).

This problem has been recognized by several of the presenters (Dartmouth Chamber of Commerce, Gordon, Northwest Arm Heritage Association, OceanChem Group, Ruffman). One presenter suggested that sewer and storm drainage systems be kept separate (Gordon). At the moment, both Halifax and Dartmouth have an extensive combined sewer and storm drainage system. Those who were concerned about storm overflow suggested that the overflow must be treated in some way, such as by incorporating storm retention tanks into the system or larger diameter pipes (accommodating over 6 times the average dry weather flow), so that all the flow in the sewer system can be treated. It was pointed out that in addition to the increased flow caused by storms, the storm runoff itself becomes contaminated prior to entering the sewer system by accumulating hydrocarbons from parking lots (OceanChem Group) and sediments from construction sites (Northwest Arm Heritage Association). It was suggested that urbanization, with an increasing reliance on paving, has reduced the effectiveness of natural soils in retaining and percolating runoff (Northwest Arm Heritage Association). It has been determined in the United States that nonpoint sources of pollution, such as storm runoff, are a greater concern than previously thought because there is poor legislative regulation of the nonpoint sources (Levenson *et al.*, 1988; Robinson and Horzepa, 1988).

The problem of storm overflows has been recognized in the Boston proposal for sewage treatment. Up to $1 billion will be spent on new systems to control raw sewage discharges from combined sewer overflows, which now run into the rivers and the harbour, resulting in beach and shellfish bed closures.

Although storm overflows in the proposed regional sewage treatment system will add only the equivalent of 3% of the current fecal coliform load to Halifax Inlet, it does mean that areas expected to have acceptable water quality in the future because of the new sewage treatment can become contaminated. The level and frequency of contamination will be unpredictable. This raises an important public perception about the regional sewage treatment scheme. If the public feels that there is a flaw in the system, their confidence in the system and their willingness to use recreational areas, which are supposed to have acceptable water quality most of the time, will be greatly reduced. The first beach closure due to a storm overflow, once the regional sewage treatment system is in place, will draw critical attention to the whole design.

In conclusion, the Review Committee feels that the concern for untreated storm overflow is legitimate. Storm overflow and runoff have been recognized as serious problems in the United States and there is an increasing effort to deal with the problem in new sewage treatment designs. The Committee feels that the proponent should examine and estimate the cost of various treatment options for flows in excess of four times average dry weather flow so that a proper cost-benefit analysis can be developed. The options that were suggested included larger diameter collector tunnels and storm retention tanks.

4.5.4 Nutrient Addition

Only one presenter dealt specifically with the problem of nutrient input to Halifax Inlet. At the moment, the addition of nitrate and phos-

phate from sewage is spread around the Metropolitan area and Herring Cove, so that nutrients are diffused throughout the Inlet. If all the sewage effluent is to be disposed through a single outfall, the nutrients can be concentrated in one area, leading to increased phytoplankton and algal production (and possibly blooms of toxic algae), and then depletion of dissolved oxygen due to bacterial decay (Buckley). There is evidence of nutrient stimulation of green algal production in Halifax Harbour and there is a suggestion that nutrients from the Tribune Head outfall lead to accelerated algal fouling of fishing nets off Herring Cove (Porter-Dillon, 1986a).

When the single plant option was compared to the multi-plant option, one of the arguments against disposal of effluent into the Harbour (the multi-plant option) was that the resultant nutrient addition to Bedford Basin could lead to eutrophication in the Basin (CBCL, 1987). This recognizes that even with secondary treatment, there is minimal removal of nutrients from the sewage. In opting for the single regional plant at Sandwich Point, it was necessary to examine the potential problem of fouling of nets due to increased production of algae. It was assumed that fouling due to nutrient enhancement of algae is possible in an area with less than 130 times dilution of the sewage effluent (ASA Consulting Ltd., 1987). With a nearshore outfall, an area with a radius of 1600 m could be affected. With a 500 m long outfall, it is reduced to an area with a radius of 600 m.

These calculations may help in comparing one outfall location to another, but there is still a concern that the assumptions about nutrient dilutions and the area of gear fouling are somewhat arbitrary, as recognized by the authors (ASA Consulting Ltd., 1987). There is also the remaining question: what is the fate of nutrients in areas with greater than 130 x dilution and what will be the cumulative effect of increased primary production (algae, diatoms) over time?

In our assessment, an assumption about nutrient loading to Bedford Basin was used to argue against effluent disposal in the Narrows. Nutrient loading at the Sandwich Point site was assessed in a simple way by making assumptions about dilution and gear fouling.

In conclusion, the Review Committee feels that the question of the effects of nutrients has not been adequately dealt with. A person knowledgeable in nutrient dynamics and primary production should examine the available data on sewage quality and composition and calculate nutrient loads and fluxes in the area of a single outfall for a regional sewage treatment plant and determine the possible increase in biomass due to enhanced primary production. The concerns about gear fouling and toxic blooms can then be better addressed.

4.5.5 Reactivation of Contaminated Sediments

Two presenters were concerned about the possibility of contaminated sediments in the harbour being oxidized once the sewage input to the harbour is eliminated (or decreased), resulting in the release of contaminants to the water column (Buckley, OceanChem Group). The low oxygen levels in the sediment pore water at the moment tend to keep contaminants, such as metals, immobilized. There is evidence from the United States and Europe that contaminated sediments can be reactivated and become a concern (Buckley).

Whether this will be a problem or not in Halifax Inlet depends on the present condition of surficial sediments in the Inlet. The Review Committee understands that sediment samples from the Inlet are being analyzed for contaminants. There is also a proposal to examine the flux of contaminants between sediments and the water column and its dependence on various geochemical parameters (Buckley).

In conclusion, the Review Committee feels that there may be a problem with reactivation of contaminated sediments, but that the results of studies currently underway will have to be interpreted before this concern can be examined properly.

4.5.6 Effects on Fisheries

Information published in 1987 indicated that there are 62 fulltime fishermen and 68 part-time fishermen within Halifax Inlet (CBCL, 1987). The nature of the fishery within the Inlet was summarized for the Review Committee by André Ducharme (Fisheries and Oceans).

At the mouth of the harbour, there is heavy lobster fishing (November 24 to May 31) all along the coast from Ferguson's Cove out to Chebucto Head. Most of the fishery occurs near the shore, but traps can be set as far offshore as 5 km, especially as the winter progresses (Dempsey). There is also heavy lobster fishing off Eastern Passage, just inside Devil's Island. There is a less intense lobster fishery on the west side of McNabs Island. Herring nets are set off Portuguese Cove out to the western boundary of the ship traffic lanes from February until September. Cod nets are set off Herring Cove at times throughout the summer. There is also a net fishery for cod and haddock about 2 km south of Devil's Island. Three Scottish seiners fish for cod southeast of Portuguese Cove. From the end of July to the end of September there is a handline fishery for mackerel, cod, and haddock in the area between Ferguson's Cove and Portuguese Cove.

There is also a commercial fishery in the Inner Harbour. There is fairly heavy lobster fishing between Ferguson's Cove and Purcell's Cove, off Point Pleasant Park, and off the northwest tip of McNabs Island. There is a light lobster fishery in the Northwest Arm and off the Nova Scotia Hospital on the Dartmouth side of the harbour. The lobsters from

this fishery tend to be large. There is generally no lobster fishery throughout other parts of the Narrows. Herring nets are set off the shore between Ferguson's Cove and Purcell's Cove from February through to the early summer and there is handlining for mackerel, cod, and haddock in the same area throughout the late summer and early fall. The fishery in Bedford Basin is much smaller compared to the Inner Harbour and the mouth of the harbour. Two fishermen catch lobsters on a casual basis on the west side of the Basin and just north of the Mackay Bridge.

Because there have been complaints in the past about the effects of the Tribune Head outfall on the fishery off Herring Cove and there is presently a concern about the regional sewage treatment proposal, the inshore fishery landings at Herring Cove over the last 5 years were examined in comparison with similar landings at Eastern Passage and Sambro. The current fishing licenses for these communities are summarized in Table 4.1.

The main purpose in comparing the landings was to determine if the temporal trend of inshore landings at Herring Cove (assumed to be from fishing near Herring Cove) differs significantly from trends at the other two communities, perhaps as a function of sewage or some other factor. The actual data are not included in this report for the sake of confidentiality, but the results of the comparison are presented by species below.

The only herring landings recorded for Herring Cove in the last five years were in 1986, when landings at Sambro and Eastern Passage were at the lowest point in the period 1983 to 1987. Mackerel landings for Herring Cove were recorded in 1985 and 1987. The landings in 1987 were considerably less than in 1985. Mackerel landings in Sambro and Eastern Passage were relatively steady from 1983 to 1985, then showed a decline in 1986 and some recovery in 1987.

Table 4.1. Summary of Current Fishing Licenses for Three Communities near Halifax (boats less than 14 m).

Licenses	Herring Cove	Sambro	Eastern Passage
Groundfish			
Ottertrawl		2	
Danish Seine		2	
Scottish Seine		2	
Set Gill Net	10	17	17
Longline	14	48	26
Jigger	1	3	
Herring	7	36	23
Mackerel	7	40	25
Lobster			
A	6	24	13
B		2	3

Inshore cod landings for all three communities showed the same trend over the last five years, with a decline between 1983 and 1985, a slight increase in 1986, and another decline to previous levels in 1987. The only haddock landings recorded for Herring Cove were in 1987 and cusk were landed in Herring Cove only in 1986. Pollock were landed in Herring Cove in 1983 and 1987, with a decline evident in the 1987 landings. Pollock landings at the other two communities were relatively stable over the last five years. The only halibut landings for Herring Cove in the last five years were in 1986. Halibut landings at Sambro and Eastern Passage showed a decline in 1984; otherwise they were relatively steady over the last five years.

Lobster landings for all three communities showed the same temporal trend over the last five years, with a steady increase between 1983 and 1985 and a marginal decline between 1985 and 1987.

Slight differences in trends in fish landings can be due to a number of factors, including changes in the level of fishing effort and regional differences in the concentration of fish due to local environmental conditions and food availability. Despite any possible differences in these factors between Herring Cove, Eastern Passage, and Sambro (the fishing areas off Sambro and Eastern Passage are assumed to have less sewage influence than Herring Cove), the trends in inshore fish landings over the last five years are similar for those species which are consistently landed at all three communities. There is, therefore, no clear evidence from the inshore fish landings that sewage at Herring Cove has affected the landings.

Concerns for the fishery near Herring Cove were first assessed in the mid-1980's. A study by Porter Dillon (1986a), in which the McIntosh Run and the Tribune Head outfall were examined, included a public meeting at which fishermen voiced their concerns about the effects of sewage on their fishery. Their concerns were tabulated as follows:

- sewage effluent seriously affecting the fishery;
- fouling of fishing nets, boats, and wharves;
- fishing berths eliminated because of excessive fouling of nets;
- fish bypassing fouled nets;
- sinking of nets due to fouling;
- difficulty in retrieving and cleaning nets;
- net life reduced by fouling;
- catch cannot be cleaned at wharf due to poor water quality;
- fishermen have to travel further to their fishing grounds;
- an oil and grease scum collects on the boats and wharves.

At this time the fishermen commented that marked decreases in "fish populations" were probably due to overfishing and not to the Tribune Head outfall (Porter Dillon, 1986a). The fishermen also felt that debris fouling of nets was more detrimental than fouling due to algae, stimulated by nutrients in the sewage.

Most of the concerns about the fishery focussed on gear fouling and a subsequent study examined the problem in more detail (Porter Dillon, 1986b). A survey of the plume from the Tribune Head outfall indicated the presence of fecal material, plastic, grease, and toilet paper suspended in the water. Despite this, there was a negligible degree of fouling of nets by large particulate material. Biofouling of experimental nets was observed, with the peak period from mid-June to September. Fouling was observed to be greater at Herring Cove than at Portuguese Cove and Sambro (Porter Dillon, 1986b), lending some support to nutrient accumulation and enhanced primary production near Herring Cove.

The proposed regional sewage treatment plant at Sandwich Point has raised many of the same concerns for the fishery near Herring Cove that were expressed several years ago. The main reason for this is that the proposed outfall for all the regional sewage is only about 2 km from Herring Cove. At the moment fishermen do not fish at any of the berths

within about 1200 m of the Tribune Head outfall (Dempsey). Although the regional sewage will undergo primary treatment, fishermen are concerned that the remaining solids, nutrients, and trace contaminants from an effluent volume ten times greater than they are receiving now will "wipe out the fishery" (Ball, Dempsey) or at least make fishing berths near Sandwich Point unfishable (Ball, Herring Cove Ratepayers Association, Ruffman). Sandwich Point has been identified as a good lobster fishing ground (Dempsey) and there is concern that this area will no longer be fit for lobster fishing. It was felt that the general concern for the fishery off Herring Cove had not been properly addressed in the past or in the planning for the proposed regional sewage treatment plant (Herring Cove Ratepayers Association, Power, Tremble). It was felt that a proper environmental impact assessment for the fisheries was warranted (Ecology Action Centre).

Concern was expressed for the possibility of lobsters and groundfish becoming contaminated with toxic compounds. Some felt that there will be consumer resistance to catches from the area and possibly real human health problems if contaminated fish and shellfish are consumed (Halifax County, Herring Cove Ratepayers Association). Some initial analysis by Porter Dillon (1986a) generally did not indicate trace metal contamination of groundfish near the Tribune Head outfall. However, three of the samples had high lead levels. Analytical results for lobsters from the area will be published in the spring of 1989 (Fisheries and Oceans). These limited data are inconclusive on the matter of whether commerical species in the harbour are contaminated or not at the moment and are not very helpful in predicting whether contamination is possible in the future. More analytical results, with careful attention to the location and habit of the sampled species, are required.

Fishermen are concerned that fouling will occur in a new area near the proposed outfall and would like to eliminate the fouling problem altogether (Herring Cove Ratepayers Association). Even though only a few

fishermen may be affected by the proposed regional sewage treatment plant, the livelihood of fishermen whose families have been fishing in the area for over 200 years must be preserved (Herring Cove Ratepayers Association). However, claims that sewage has already resulted in lower catches and reduced quality (Ball, Ruffman) cannot be substantiated with the available data on landings (noted previously). It is likely that the current problems with sewage require an increased effort to catch fish. Fishermen feel that secondary treatment of sewage could reduce fouling of nets and therefore the time and cost spent in removing and cleaning the nets (Halifax County). A study by ASA Consulting Ltd. (1987) suggested that the area in which fouling of gear due to nutrient enhancement could occur would be as follows:

- a circular area with a 1600 m radius for an outfall 140 m from shore; or

- a circular area with a 600 m radius for an outfall 500 m from shore.

The deeper outfall (at 500 m) would clearly be better, in terms of potential gear fouling, than the shallower outfall.

There were some comments about the potential for shellfish harvesting within Halifax Inlet. At the moment, shellfish harvesting is closed in the Inlet and all along the shore to Chebucto Head due to high coliform levels (Ducharme, Fisheries and Oceans). With the proposed sewage treatment scheme, there would be a significant improvement in water quality within the Inlet, but storm overflows could result in shellfish closures near McNabs Island, at the head of the Northwest Arm, in the Narrows, and at various points in Bedford Basin. One presenter wanted to see shellfish harvesting in the Northwest Arm (Northwest Arm Heritage Association). Even with sewage treatment and a reduction in coliform levels, one might still be concerned about consuming shellfish which can accumulate toxic compounds which are not removed from the sewage.

The concern over the potential effects of a regional sewage treatment plant on the fishery in Halifax Inlet and especially off Herring Cove is an emotional issue. Discussions about the fishery in the past have been mired in a debate about politics and regional priorities. Because of this, it appears that concerns over the fishery have not been addressed objectively and comprehensively. The Review Committee has tried to assess all the available information and comments to develop a clear picture of the real issues. This assessment is presented below.

There is a substantial fishery in Halifax Inlet and adjacent waters. Although the number of fishermen operating in the area is not very large, the fishery is important as a livelihood and way of life to those fishermen and they would probably not willingly accept compensation to stop fishing, if the effects of a new regional sewage treatment scheme on the fishery were severe enough to warrant a fishery closure. However, compensation for fisheries effects may come up in the future and the proponent of the regional sewage treatment scheme should consider developing a policy to handle claims.

An examination of inshore fish and shellfish landings for three communities near Halifax, including Herring Cove, did not reveal any substantial difference in temporal trends between communities which might reflect varying exposure to sewage in the last five years. Similarly, very limited habitat surveys near Herring Cove did not indicate habitat degradation due to sewage. This could be real or it could reflect the lack of detailed habitat analysis. The most valuable fishery in the Inlet is lobster fishing and most of the concern focusses on this resource. The landings for lobster in particular show nothing catastrophic going on near Herring Cove. However, there may be more subtle effects from sewage. There is evidence that the lobsters in Halifax Inlet are fast growers compared to those from adjacent areas, which suggests more food or elevated water temperatures, which may be related to sewage input. There is also some very limited evidence of contamination of lobsters in the Inlet.

The concern for physical degradation of lobster habitat due to a single outfall for all the regional sewage can probably be reduced if the outfall is placed well away from lobster grounds and if there is assurance that there will be no substantial settlement of resuspended effluent material on the lobster habitat. The concern for contamination of lobsters (and groundfish) by toxic compounds in the sewage effluent is more difficult to deal with, because there is inadequate information on sewage composition and circulation patterns at the proposed outfall such that the fate of potential contaminants can be accurately predicted. The hint of contamination of lobsters at the moment leads to some urgency in resolving or at least in better understanding this issue. If toxic compounds will remain in the effluent, it may be wise to place the outfall as far away as possible from fishing grounds in an area where high dilution and transport of water out of the area will reduce the risk of contaminants being taken up by fish and shellfish. An important point to consider is that if the public fears tainting or contamination of fish and shellfish from the outfall area, there may be a loss of public confidence in the catch and this could have serious economic effects on the fishery.

There is some evidence of gear fouling at the moment, due to nutrient input and accelerated growth of diatoms and algae. This problem may remain and may in fact occur in a larger area than at present if the outfall is placed off Sandwich Point. This is considered a nuisance factor which makes it difficult for fishermen to work fishing grounds where fouling occurs. However, the peak in fouling occurs in mid-summer when the inshore fishery is at a minimum. More analysis of nutrient dynamics and circulation at the proposed outfall is required before the potential problem of gear fouling can be properly assessed. Placement of the outfall as far away as possible from fishing grounds would obviously reduce the risk of gear fouling. Fouling due to accumulation of particulate material on gear should be minimal with primary treatment of the sewage.

Shellfish harvesting (clams, mussels) may be possible in some areas of Halifax Inlet once a regional sewage treatment plant is in operation. However, if toxic compounds remain in the effluent after treatment, consumption of some shellfish which are free of coliform bacteria may not be wise if there is a risk that contaminants have accumulated in the shellfish.

In conclusion, the Review Committee believes that more information on the composition and fate of the effluent from the proposed regional sewage treatment plant must be obtained before a proper assessment of potential fisheries effects can be made. If the public perceives any problem at all with catches from Halifax Inlet, a depression in fish and lobster sales in general is possible, so potential fisheries effects must be avoided. At the moment, there is a suggestion that gear fouling will occur near the proposed outfall and that contamination of fish and shellfish in the Inlet is possible over the long-term, if there is no removal of toxic compounds from the sewage and if there is any movement of these compounds from the outfall to fish and lobster habitat. These problems can be mitigated by placing the outfall as far away as possible from fish and lobster habitat in an area with deep water and substantial water movement.

4.5.7 Effects on Whales

Two presenters were concerned about the effect of the sewage treatment plant effluent on whales which feed in the waters near Halifax (Northwest Arm Heritage Association, VanderZwaag). The concern was raised without suggestions as to what the effect may be.

The Review Committee understands that the whales which can often be seen near Halifax are feeding on herring and other animals such as crustaceans. If the sewage effluent were to influence these food species, then the whales would be directly affected. The effect of the effluent on the food species cannot be accurately predicted. Some may be

attracted to the organic material in the effluent plume, whereas others, such as herring, may avoid the poor water quality in the plume. Whales which might be attracted to high concentrations of food species in the plume could detect poor water quality and avoid the plume as well. The net effect of the sewage effluent plume on whales may only be displacement of feeding activity to areas beyond the influence of the outfall.

In conclusion, the Committee feels that there is not enough information to properly assess the effect of the sewage effluent on whales, but suspects that it will probably be negligible.

4.5.8 Effects of Chlorine

One presenter questioned the possible effect of chlorine from the chlorination process on the marine environemnt (VanderZwaag). An earlier report suggested that the chlorine could form toxic compounds such as chloramines (Applied Marine Research Limited, 1976).

The Review Committee does not have enough information on the reaction of chlorine with other compounds in sewage effluent and with seawater to assess this concern. The Committee also does not have information on the volume of chlorine to be used on a daily basis and the expected chlorine concentration at the proposed outfall.

Some simple calculations of loading and dilution would be a first step in assessing the effects of chlorine on the marine environment.

4.5.9 Sludge Disposal

There was considerable discussion of the concern for sludge disposal. One of the sludge disposal options being considered for the project is the sludge-to-oil technology. Several Herring Cove residents

were concerned that a sludge-to-oil plant at Sandwich Point would turn the site into an industrial complex (Herring Cove Ratepayers Association; Tremble). Others insisted that the proposed sludge processing accept various sludges (such as that produced at Halifax County sewage treatment plants) and septic wastes (Halifax County). The County is concerned that if they invest in sludge lagoons in their own jurisdiction, this may end up being a waste of money if they can eventually tie in to sludge processing at the regional sewage treatment plant (Lichter). Two presenters were concerned about an increase in truck traffic to handle the processed sludge and to bring additional sludge from Halifax County (Ball, Gordon). One presenter wanted more information on the sludge-to-oil technology and expressed concern about toxic compounds in the sludge, emissions from the process, and disposal of the ash (Ecology Action Centre). Another individual cited the Boston plan to produce fertilizer from sludge and noted that high nutrient-content sludge in Florida is dried and used as fertilizer for golf courses (Pelham). One presenter emphasized that the sludge disposal problem needs to be resolved before the sewage treatment plant is constructed (Dartmouth Chamber of Commerce).

The Review Committee understands that a project on a sludge handling strategy for the regional sewage treatment plant, including sludge from Halifax County, has been commissioned by the N.S. Department of the Environment. A review of the terms of reference indicates that all the concerns noted above are to be addressed in the study. However, the study is limited to considering sludge from the primary clarifier only, which implies that secondary treatment of the sewage, which generates a larger volume of sludge, is not considered an option now or in the near future. The final strategy for sludge handling could be the main criterion dictating the degree of sewage treatment. In the opinion of the Review Committee, this is a limitation in the sludge handling strategy project.

In conclusion, sludge disposal is a significant problem requiring careful study. Most of the concerns mentioned by the public will be addressed in the N.S. Department of the Environment study. However, that study could be more effective if sludge from secondary treatment is included as well.

4.5.10 Monitoring Requirements

There was little discussion of monitoring requirements by the public, but a few of the reports on Halifax Inlet sewage treatment and some of the presenters emphasized the importance in monitoring the effectiveness of the regional sewage treatment scheme (H.J. Porter, 1977; CBCL, 1987; Environment Canada, OceanChem Group, Fisheries and Oceans). It was stated that a baseline study is required at the proposed outfall, including sediment contaminants and animals. Post-construction monitoring must be done to confirm that the level of treatment is satisfactory in maintaining the desired water quality standards (H.J. Porter, 1977).

The Review Committee did not have the time and resources to examine exhaustively water quality monitoring programs in other jurisdictions. However, a few recent examples provided some basis for discussing the requirement for monitoring.

Monitoring of the sewage treatment plant operation and the receiving environment will be essential to determine the effectiveness of the plant in treating the sewage, to measure the rate at which the water quality objectives are achieved, and to ensure that the water quality objectives are maintained over time. In designing an appropriate monitoring program, it is important to measure plant inflow and composition, as well as the flow and pollutant loads from the plant to obtain an accurate picture of plant effectiveness (Burroughs and Lee, 1987). The dependent

variables which should be measured to reflect the effect of the sewage treatment plant on the receiving environment include water quality data such as dissolved oxygen, bacteria, nutrients, metals and hydrocarbons. However, in order to properly determine the real effect of the treatment plant on the receiving environment, other pollutant loads which may affect the water quality data need to be monitored. These could include river discharge, atmospheric fallout, and runoff (Burroughs and Lee, 1987). In the worst possible situation (not probable in the case of Halifax Inlet), the sewage treatment plant would cause only a marginal improvement in water quality if all other pollutant loads continued unchecked. Proper before-plant and after-plant monitoring of the appropriate variables at well-positioned stations should provide reliable information on plant effectiveness and receiving water quality. The New York Harbour water quality monitoring program, which has been running since 1909, was examined. The program, which includes measurements of dissolved oxygen, BOD, coliform bacteria, nutrients, and heavy metals, has convincingly measured the effects of plant additions, treatment upgrading, legislated industrial pretreatment processes, and general compliance with State water quality standards (Brosnan et al., 1987). It would be useful to examine this particular monitoring program and others prior to establishing a monitoring program for the Halifax Inlet regional sewage treatment scheme.

In conclusion, the Review Committee feels that a comprehensive monitoring program must be implemented for the project. It must be very carefully designed to ensure that it properly measures treatment plant effectiveness, the effect of the plant on receiving water quality, and our progress towards achieving established water quality objectives.

4.5.11 Economic Effects and Future Development

There were a few questions about the economic effects of the regional sewage treatment proposal and some concerns about future development

related to the project. One presenter was concerned that the plant location at Sandwich Point could accelerate growth in Halifax Mainland South, resulting in increased runoff from construction sites into the Northwest Arm (Northwest Arm Heritage Association). Another was concerned that if such development were to occur, there would be increased traffic on roads that are already clogged during rush hour (Zuk). One presenter wondered about the effect of the plant at Sandwich Point on property values (VanderZwaag). One Herring Cove resident wanted to know if water and sewerage will be provided to their community in the future as part of this project (Tremble).

The Review Committee does not have the expertise to properly assess economic effects and future development. It is possible that concerns about them are legitimate and should therefore be addressed by a socio-economist.

5.0 SUMMARY OF CONCERNS

5.1 INTRODUCTION

The concerns identified in Section 4 and the Review Committee's assessment of those concerns are repeated below as a preamble to the Committee's recommendations on the regional sewage treatment proposal.

5.2 THE PLANNING PROCESS

There was a favourable response to the Committee, but concern about its effectiveness. There must be serious consideration of the Committee's recommendations in the design of the regional sewage treatment plant to maintain public confidence in such committees. (p. 4.3)

If the public feels that not enough information has been provided, and recognizing that most will not be able to review the technical reports, they must be provided with more details in layman's terms before final decisions on the project are made. This information should be provided by the project proponent. (p. 4.4)

The regional sewage treatment proposal has been perceived as a political issue. Sensitivity to public concerns is extremely important if the final sewage treatment design is to be accepted as the correct socioeconomic and environmental decision. (p. 4.5)

Public participation in the planning process for the proposed regional sewage treatment scheme has been inadequate. The public must be reassured that they will have an opportunity to be involved in the near future, before critical decisions are made, and should be provided with the format for public participation in the planning process. Delays due to public participation should not be an excuse for failing to involve the public. (p. 4.6)

All elements of the proposal should be directed to the best possible cleanup of the Harbour and adjacent water. If one element of the proposal compromises the effectiveness of another, the tradeoff in terms of harbour cleanup should be clearly defined, so that decisions on the final design do not lose sight of the ultimate objective of the project. (p. 4.7)

In order to encourage public contribution to the project, the management structure should properly reflect regional and various sector interests. There should also be enough flexibility in the schedule for proper planning and additional studies. Urgency for time should not be the sole criterion for setting the schedule. (p. 4.9)

It appears that the regional sewage treatment proposal has been developed without an accepted definition of water quality objectives. This raises the question: is the proposed sewage treatment plant the best option to meet a general consensus on what the Harbour and adjacent waters should be used for? (p. 4.11)

5.3 DESIGN

From purely the engineering and economic points of view, there does not appear to be a clear case for either the single plant or multi-plant options. An initial modelling assessment of BOD and coliform bacteria and assumptions about nutrient loading to Bedford Basin lend some support to the single plant option (with discharge as far away as possible from the Narrows). However, people living near the proposed location of the single plant feel that there is not enough information on the fate of the plant effluent to convince them that their marine waters will not be further degraded. They reject the single plant option (with a short outfall) on these grounds. Unfortunately, one cannot assure these people that the effluent from the plant will not affect them. It is therefore necessary to conduct more detailed studies of the possible fate of the

plant effluent and perhaps consider an option for a longer outfall which will ensure that there is no further degradation of coastal waters near Halifax and Herring Cove. (p. 4.14)

The Sandwich Point site can be neither defended nor rejected until it has been adequately compared to other sites which may offer at least the same or more improvement in Halifax Inlet. The comparison should include the cost of various outfall lengths, since the outfall location is the ultimate concern in comparing one site to another. Whichever site is picked, there should be assurance that water quality objectives for the whole area of interest can be met. (p. 4.17)

It is the Review Committee's opinion that the sewage treatment proposal does not include a comprehensive enough comparison of the various levels of sewage treatment, in combination with various plant and outfall locations (including an option of one long outfall with preliminary sewage treatment). It would be very useful if the cost and removal efficiencies of each of the levels of treatment were compared, so that the additional cost of removal increments can be brought into the decision-making for the plant. In the absence of a convincing case for primary sewage treatment at Sandwich Point, various presenters have suggested their own options, without presenting any better case than MAPC. It is clear to the Review Committee that detailed listing of constraints (mapping of activities and sensitivities) must be completed and water quality objectives set before outfall locations and various degrees of sewage treatment can be properly determined. (4.22)

The Review Committee feels that there must be comprehensive oceanographic studies carried out as soon as possible to determine the optimal location within Halifax Harbour and adjacent waters for a regional sewage treatment plant and outfall. The required studies should not just focus on the Sandwich Point site at the expense of a greater knowledge of circulation at the mouth of the harbour. The new oceanographic data

should be used to refine and expand the numerical model of Halifax Inlet. (p. 4.25)

The outfall location has been constrained by the proposed location of the regional sewage plant at Sandwich Point and possibly a desire to keep the outfall cost at a minimum. The concern for water quality and fisheries effects which started with the Tribune Head outfall has been perpetuated because the proposed outfall location is only about 2 km from the existing outfall and still very close to fishery berths and lobster grounds. Regardless of the level of treatment, the effluent from the plant will still be perceived to be noxious and therefore should be placed as far away as possible from areas that support resource use and recreational activities. If one assumes that an outfall does <u>not</u> have to be adjacent to the sewage treatment plant, the logical approach to selection of an outfall location is to develop a sensitivity or constraint map for the harbour and adjacent waters, establish a knowledge of circulation (including the wind-driven component) in the study area, develop objectives for water quality and use, and then pick a number of outfall location options. It would be useful to include at least one option for an outfall 10 km offshore in 45 m water depth, for the sake of cost-benefit analysis. Perhaps it would be useful to consider the best outfall location prior to a final decision on the location of the regional sewage treatment plant(s). (p. 4.26)

The Review Committee observes that there is little discussion of sewage treatment in other jurisdictions in the literature on Halifax Harbour regional sewage treatment. The examples cited by several presenters are not analogous and therefore have limited use in designing the system. However, it would perhaps be useful to examine the Boston sewage project from a planning point of view, to determine how the design evolved and how the public concerns were accommodated. It is also suggested that some effort should go into finding several examples similar to Halifax Inlet in which regional sewage treatment has been implemented and monitored. (p. 4.28)

5.4 CONSTRUCTION

Tunnelling may cause damage to wells in the area between Purcell's Cove and Herring Cove. Proper surveys must be carried out prior to construction if the Sandwich Point site is selected. A policy for assessing well damage, provision of water in the event of disruption, and fair compensation must be developed with public input prior to final site selection, so that the potential cost of repairing wells and/or providing alternative sources of water can be assessed. A policy must also be developed for handling the material from tunnelling. (p. 4.31)

5.5 OPERATION

Tunnel leaking may be a concern for those who rely on groundwater for their water supply. The concern cannot be properly assessed without more detailed study of the issue. The engineering design should consider the potential problem of tunnel leaking. (p. 4.32)

The concern for hazardous wastes in the sewage system is legitimate, considering that industrial waste is currently dumped into the harbour via the sewage system and that even high levels of sewage treatment are ineffective in removing some of the more soluble toxic compounds. A high dilution rate could be considered as some form of accommodation of the hazardous waste, but the Review Committee feels that it is unwise to spend $200 million on a sewage treatment scheme and have the benefits of the scheme compromised by poor hazardous waste control. Hazardous wastes should be eliminated from the sewage system as much as possible. This can be accomplished by public education and enforcement of comprehensive municipal by-laws, as recommended by the Minister's Task Force on Hazardous Waste Management. (p. 4.33)

The Review Committee feels that the concern for untreated storm overflow is legitimate. Storm overflow and runoff have been recognized

as serious problems in the United States and there is an increasing effort to deal with the problem in new sewage treatment designs. The Committee feels that the proponent should examine and estimate the cost of various treatment options for flows in excess of four times average dry weather flow so that a proper cost-benefit analysis can be developed. The options that were suggested included larger diameter collector tunnels and storm retention tanks. (p. 4.35)

The question of the effects of nutrients has not been adequately dealt with. A person knowledgeable in nutrient dynamics and primary production should examine the available data on sewage quality and composition and calculate nutrient loads and fluxes in the area of a single outfall for a regional sewage treatment plant and determine the possible increase in biomass due to enhanced primary production. The concerns about gear fouling and toxic blooms can then be better addressed. (p. 4.37)

The Review Committee feels that there may be a problem with reactivation of contaminated sediments, but that the results of studies currently underway will have to be interpreted before this concern can be examined properly. (p. 4.38)

More information on the composition and fate of the effluent from the proposed regional sewage treatment plant must be obtained before a proper assessment of potential fisheries effects can be made. If the public perceives any problem at all with catches from Halifax Inlet, a depression in fish and lobster sales in general is possible, so potential fisheries effects must be avoided. At the moment, there is a suggestion that gear fouling will occur near the proposed outfall and that contamination of fish and shellfish in the Inlet is possible over the long-term, if there is no removal of toxic compounds from the sewage and if there is any movement of these compounds from the outfall to fish and lobster habitat. These problems can be mitigated by placing the outfall

as far away as possible from fish and lobster habitat in an area with deep water and substantial water movement. (p. 4.47)

The Committee feels that there is not enough information to properly assess the effect of the sewage effluent on whales, but suspects that it will probably be negligible. (p. 4.48)

Some simple calculations of loading and dilution would be a first step in assessing the effects of chlorine on the marine environment. (p. 4.48)

Sludge disposal is a significant problem requiring careful study. Most of the concerns mentioned by the public will be addressed in the N.S. Department of the Environment study. However, that study could be more effective if sludge from secondary treatment is included as well. (p. 4.50)

The Review Committee feels that a comprehensive monitoring program must be implemented for the project. It must be very carefully designed to ensure that it properly measures treatment plant effectiveness, the effect of the plant on receiving water quality, and our progress towards achieving established water quality objectives. (p. 4.51)

The Review Committee does not have the expertise to properly assess economic effects and future development. It is possible that concerns about them are legitimate and should therefore be addressed by a socio-economist. (p. 4.52)

6.0 RECOMMENDATIONS

6.1 INTRODUCTION

The Halifax Harbour Cleanup Review Committee would first of all like to make it clear that it recognizes the effort of MAPC, its consultants, and various Government departments in conceiving of a regional sewage treatment scheme and obtaining the necessary funds to make regional sewage treatment a reality. This is clearly the most important step in correcting the serious problem of raw sewage disposal into Halifax Inlet. The recommendations that follow are not intended to detract from this significant achievement. Rather, they have been developed to provide support to the final planning and design decisions that are necessary to ensure the most effective regional sewage treatment possible.

The recommendations of the Review Committee are not listed according to priority or order of implementation. In the opinion of the Review Committee, all the recommendations are important and all should be implemented as soon as possible.

6.2 THE PLANNING PROCESS

The Halifax Harbour Cleanup Review Committee recommends that:

1. The Minister of the Environment adopt the recommendations of the Halifax Harbour Cleanup Review Committee and encourage their incorporation into the planning and design for the regional sewage treatment scheme.

2. The Review Committee's report be made available to the public.

3. The proponent establish a mechanism to allow the public participation in the planning process and design of the regional sewage treatment scheme. This may be done by establishing a committee representing various sectors and interest groups.

4. An information program on sewage treatment in general and options for Halifax Inlet be prepared and distributed to the public, prior to any final decisions on a design.

5. The project management regime for the proposed regional sewage treatment scheme include representation from the general public in an advisory capacity.

6. Water quality objectives and intended uses of Halifax Inlet and adjacent waters be defined with public input prior to finalizing the regional sewage treatment scheme.

7. The Boston project be reviewed to enhance our knowledge in terms of the public participation process and public relations related to these types of projects.

6.3 DESIGN CONSIDERATIONS

The Halifax Harbour Cleanup Review Committee recommends that:

8. Individual elements of the proposed design (e.g. treatment level, outfall location, sludge treatment) which impose limits on the effectiveness of other elements be clearly defined by the proponent so that the optimal design is achieved.

9. The proponent allow time for the required studies prior to final design of the regional sewage treatment scheme.

10. A comprehensive map of sensitive resources, resource use, and any other features which may be influenced by sewage in Halifax Inlet and adjacent waters be developed as soon as possible to aid in setting water quality objectives and site selection for the plant and outfall.

11. Oceanographic studies of the harbour and adjacent waters (including Sandwich Point and Hartlen Point options) be completed as soon as possible. The studies should include adequate current meter, drifter, and climatological data to allow a confident prediction of the fate of the effluent plume at various locations at the mouth of the harbour. The studies must be developed in consultation with Fisheries and Oceans.

12. Sediment parameters and contaminants, and their present effects on commercial fish species are not known and, therefore, must be determined.

13. An examination of regional sewage treatment in areas similar to Halifax Inlet be completed.

14. The pros and cons of a single plant option (at various locations, including at least Sandwich Point and Hartlen Point) and the multi-plant option be clearly tabulated, including cost, engineering constraints, various levels of sewage treatment, scheduling, future servicing requirements, allowance for future expansion, and environmental effects. The proponent should include one option for one long outfall beyond the mouth of the Harbour in this comparison.

15. Sufficient pipe and pumping capacities be examined in the near future to accommodate the Mill Cove and Eastern Passage sewage treatment plant feeds or, alternatively, the treated effluents from the plants. Future consideration should be given to collect sewage for treatment from residents who have septic tanks along the sewage collector tunnels.

16. Attractive landscaping, noise reduction, odour reduction, and air pollution abatement be included in the final design for the sewage treatment plant.

17. Sufficient area be reserved at the site of the sewage treatment plant to allow expansion in the future. The plant should be constructed in such a way that higher levels of treatment can be easily added if water quality objectives and intended uses of Halifax Inlet are not achieved with lower level treatment.

18. Adequate stand-by equipment and facilities be incorporated into the design of the treatment plant to allow continuous full-scale operation during power interruptions.

6.4 CONSTRUCTION CONCERNS

The Halifax Harbour Cleanup Review Committee recommends that:

19. A policy for damage to property and water supply due to blasting, excavation, and tunnelling be developed with public input.

20. A plan to deal with tunnelling material in an environmentally safe manner be developed.

6.5 OPERATIONAL CONCERNS

The Halifax Harbour Cleanup Review Committee recommends that:

21. The possibility of tunnel leaking be assessed.

22. Regulations be enacted and diligently enforced by all levels of Government to prevent the discharge of hazardous waste into the sewage system.

23. A program be established to collect and segregate industrial and domestic hazardous wastes, ensuring either storage and treatment in the area or shipment elsewhere where they can be properly disposed of.

24. Options for treating storm overflow be examined and the costs of the various options estimated.

25. Nutrient dynamics and production of algae and diatoms associated with the proposed regional sewage treatment scheme be examined and predicted for the various options.

26. The fate of individual components in the effluent be accurately predicted for each of the proposed outfall options. This should then form the basis of a proper fisheries impact assessment to be carried out as a separate project.

27. A policy for dealing with claims by fishermen related to the regional sewage treatment plant be developed.

28. Final sludge disposal options be addressed immediately in order to arrive at environmentally acceptable solutions.

29. The sludge-to-oil process be evaluated to develop operating parameters to effectively treat or convert sludges from both primary and secondary treatment. The possibility of accepting septic sludges should be explored.

30. A comprehensive monitoring program be designed and implemented. Regulatory agencies should review the final monitoring design.

6.6 CONCLUDING REMARKS

The Halifax Harbour Cleanup Review Committee recognizes that even with higher levels of sewage treatment, residual materials in the treated effluent and occasional untreated overflows could cause degradation of the receiving environment near the outfall. It therefore endorses the concept of eliminating sewage treatment plant effluents from the Inner Harbour and sensitive areas at the mouth of the Inlet. Regardless of the location of the sewage treatment plant(s), this can be achieved by consolidating the effluent(s) in an extended outfall which diffuses in deep water (providing adequate dilution) in an area where there is enough water movement to transport the effluent plume away from the outfall and away from any sensitive areas.

The Review Committee supports the concept of a single regional sewage treatment plant, as long as the objectives noted above can be met. The Committee feels that the outfall location is of more concern than the plant location. Oceanographic studies are required to support selection of an outfall site. Once the optimal outfall site has been picked, it will be possible to confirm or reject the proposed Sandwich Point site. The level of sewage treatment should be based on whatever is necessary to achieve water quality objectives throughout the whole of Halifax Inlet.

The Committee cannot support or reject the Sandwich Point location with regard to the commercial fishery because of the lack of information. Although there have been numerous sewage treatment studies to date, there is no conclusive evidence that the fishery will not be affected.

7.0 ACKNOWLEDGEMENTS

The Halifax Harbour Cleanup Review Committee acknowledges the valuable contributions made to this report by the individuals and organizations who prepared written submissions or made oral presentations to the Committee.

Also, various Government agencies, such as the Metropolitan Area Planning Commission, Environment Canada, Fisheries and Oceans, and the Bedford Institute of Oceanography, provided expert advice and assistance during the review of the various studies relating to the sewage treatment proposal.

The Review Committee thanks Ms. Dianne Coish, Ms. Lynn Brenton, Messrs. Neil Brodie and Frank Potter of the N.S. Department of the Environment, David Darrow of the Department of Municipal Affairs, George Reid of the Department of Industry, Trade and Technology, and John Carter of Martec Limited, who acted as resource staff to the Committee.

Without the support of all of these people and the interest of provincial and federal departments of government, this report could not have been completed.

Again, the whole undertaking could not have been finished without the concern and input of those interested individuals and groups who gave submissions to the Review Committee.

8.0 LIST OF REFERENCES

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APPENDICES

APPENDIX A

TERMS OF REFERENCE OF THE REVIEW COMMITTEE

ENVIRONMENTAL CONTROL COUNCIL

HALIFAX HARBOUR CLEANUP REVIEW COMMITTEE

TERMS OF REFERENCE

Review Committee

The Review Committee and its Chairperson shall be appointed by the Chairperson of the Environmental Control Council. The Review Committee shall report to the Environmental Control Council which shall in turn report to the Minister of the Environment.

Objectives

The Metropolitan Area Planning Commission have recommended that the Regional Pollution Control Strategy be based upon a single regional primary sewage treatment plant at Sandwich Point, Halifax County but have agreed that the potential impact on the commercial fishery at Herring Cove requires evaluation.

The objective of the Review Committee is to provide a third party review of the impacts of this project with primary emphasis on the commercial fishery.

Following a complete review of existing relevant information and input from interested parties, the Committee shall produce a report to be delivered to the Minister which will advise on the potential impacts on the commercial fishery and the marine ecosystem, identify unknowns remaining and recommend need and options for mitigation of potential or anticipated impacts.

Scope of Work

1. The Committe shall review all relevant information in the form of existing reports and within the federal/provincial/municipal government structures.

2. The Committee shall request and provide opportunity for public sector submissions on their perception and views on the project. In order to facilitate informed public input, the Committee shall make available resource materials and sufficient time to allow submissions to be made.

3. The Committee shall insure that federal departments, particularly Environment Canada and Fisheries and Oceans are afforded full opportunity to make submissions.

4. The Committee shall assess the commercial fishery impacts as their primary area of concern but also look at marine ecosystem impacts and other issues which they or others identify. The issues shall be reviewed in the light of all information collected and an assessment of the anticipated/potential impacts made.

5. The Committee shall identify all adverse impacts which they anticipate will arise from the proposed project. They shall provide recommendations where applicable for mitigation of these impacts. They shall clearly advise on the acceptability of the environmental impact of the project with or without mitigation measures.

APPENDIX B

COMMITTEE MEMBERSHIP

HALIFAX HARBOUR CLEANUP REVIEW COMMITTEE

MEMBERSHIP FROM THE ENVIRONMENTAL CONTROL COUNCIL

Mr. Harry Cook P.O. Box 9 Bridgewater, N.S. B4V 2W7 Ph.: 543-8184	representing Municipalities
Mr. Stephen Craig 26 Strathmore Avenue Lower Sackville, N.S. B4C 2S7 Ph.: 865-0778	representing Industry
Mr. Crosby McLeod Port Mouton Queens Co., N.S. B0T 1T0 Ph.: 683-2023	representing Fisheries
Mr. Mike McGill P.O. Box 427 Truro, N.S. B2N 5C5 Ph.: 895-5528	representing Engineering
Mr. James Harrison 55 Elwin Crescent Dartmouth, N.S. B2W 3J9 Ph.: 434-5497	representing Conservation (Chairman)

SUPPORT STAFF:

Ms. Lynn Brenton	N.S. Department of the Environment
Ms. Dianne Coish	N.S. Department of the Environment
Mr. Frank Potter	N.S. Department of the Environment
Mr. John Carter	Martec Limited (Consultant)

APPENDIX C

BIBLIOGRAPHY - REFERENCES AVAILABLE AT THE NOVA SCOTIA DEPARTMENT OF THE ENVIRONMENT LIBRARY

HALIFAX HARBOUR CLEANUP

BIBLIOGRAPHY (N.S. DEPARTMENT OF THE ENVIRONMENT LIBRARY)

Title:	Report and Technical Discussion on Sewage Works and Drainage for the City of Halifax
Author:	MacLaren Atlantic Limited
Date:	1970
# of Pages:	approx. 200
Library #:	H173 70/01

Title:	Report on Regional Pollution Control Halifax-Dartmouth Metropolitan Area
Author:	Metropolitan Area Planning Committee. Task Group on Water Supply and Waste Disposal (MAPC)
Date:	1971
# of Pages:	1 v. (various pagings)
Library #:	H173.3 71/11

Title:	Oceanography of the Halifax Inlet in Relation to Problems of Sewage Disposal
Author:	Riley, Gordon A. Pease, Alan Loucks, Ronald Dalhousie University. Institute of Environmental Studies Nova Scotia Department of the Environment
Date:	1974
# of Pages:	44 pages
Library #:	H173 74/09

Title:	A Consideration of the Ecological Effects of Sewage Discharge into Halifax Inlet
Author:	Applied Marine Research Limited
Date:	1976
# of Pages:	
Library #:	H173.3 77/08 APPENDIX C

Title:	Metropolitan Area of Halifax, Dartmouth and Halifax County Regional Pollution Control Study
Author:	H.J. Port and Associates Limited Metropolitan Area Planning Commission. Pollution Control Advisory Group (MAPC)
Date:	1977
# of Pages:	1 v. (various pagings)
Library #:	H173.3 77/08

Title: Halifax-Dartmouth Regional Plan Review: Sewerage, Water Supply and Storm Drainage Study: Phase 1 Inventory
Author: MacLaren Engineers, Planners & Scientists Inc.
Date: 1981
# of Pages: 1 v. (various pagings) + 4 maps
Library #: H173.5 81/11

Title: Sewage Pollution from a Marine Outfall: Halifax Harbour
Author: Seatech Investigation Services Limited
Date: 1982
# of Pages: 11 pages
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Title: Halifax-Dartmouth Regional Development Plan Review: Water Supply, Sewerage, and Storm Drainage: Task Force Report
Author:
Date: 1980
# of Pages: 43 pages
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Title: The Halifax Inlet Water Quality Study Phase I - Data Review
Author: ASA Consulting Ltd.
Date: January 1985
# of Pages: 42 pages
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Title: Herring Cove Sewage Outfall Study
Author: Porter Dillon Limited
Date: 1985
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Title: Herring Cove Sewage Outfall Study: Monitoring Extension Addendum #1
Author: Porter Dillon Ltd.
Date: 1986
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Library #:

Title:	Report of the Halifax Harbour Monitoring Program
Author:	Nova Scotia Department of the Environment
Date:	1986
# of Pages:	1 v. (various pagings)
Library #:	H173 86/05

Title:	The Halifax Inlet Water Quality Study Phase II
Author:	ASA Consulting Ltd.
Date:	August 1986
# of Pages:	Volume 1 and Volume 2
Library #:	H173.4 86/08

Title:	The Halifax Inlet Water Quality Study Phase III
Author:	CBCL Ltd.
Date:	May 1987
# of Pages:	122 pages
Library #:	H173.4 86/08

Title:	The Halifax Inlet Water Quality Study Phase 3 - Executive Summary
Author:	CBCL Ltd.
Date:	May 1987
# of Pages:	25 pages
Library #:	H173.4 86/08

Title:	Halifax Inlet Regional Pollution Abatement System: Impact Analysis of Sewage Treatment Options for Herring Cove Area
Author:	Metropolitan Area Planning Commission
Date:	1987
# of Pages:	55 pages
Library #:	H564 87/11

Title:	Halifax Inlet Study: Flow Gauging and Sampling Program 1987
Author:	Metropolitan Area Planning Commission
Date:	1986
# of Pages:	18 pages
Library #:	H173 88/03

APPENDIX D

NEWSPAPER ADVERTISEMENT

HALIFAX HARBOUR REVIEW COMMITTEE CALL FOR SUBMISSIONS

The Nova Scotia Environmental Control Council has established a Review Committee to study the possible location of a single regional sewage treatment plant at Sandwich Point. Primary emphasis of the review will be on the commercial fishery. Written or oral submissions will be accepted by October 21, 1988.

Send written submissions to:

The Halifax Harbour Cleanup Review Committee
Nova Scotia Environment Control Council
P.O. Box 2107
Halifax, Nova Scotia
B3J 3B7

Appointments for oral submissions and requests for information can be made by calling:

424-5300 (ext. 146)

The Committee's report will be submitted to the Environmental Control Council, which in turn will report to the Minister of the Environment.

APPENDIX E

INFORMATION PACKAGE ON THE PROJECT PROPOSAL

PROJECT PROPOSAL

HALIFAX HARBOUR CLEANUP

1. BACKGROUND

Catering to major transportation, tourism, recreation, fishing and national defence interests, Halifax Harbour is one of Nova Scotia's and, indeed, one of Atlantic Canada's most valuable natural resources. Detracting from the present and future potential value of this resource, however, are high levels of pollution caused by a lack of sewage treatment in the Halifax-Dartmouth area.

Approximately 44 million gallons of wastewater is generated on a daily basis by the 260,000 persons living and working in the Halifax-Dartmouth Metropolitan Area. Sewage treatment plants located at Eastern Passage and Mill Cove treat roughly 6 million gallons of sewage per day, or less than 15 percent of the total sewage discharged to the waters of Halifax Inlet. The remaining 38 million gallons of sewage per day enters Halifax Inlet waters untreated from more than 40 sewer outfalls along the Halifax and Dartmouth waterfronts.

The impact of raw sewage discharge on the visual or aesthetic environment is readily apparent to even the most casual waterfront observer. Significant accumulations of solids have occurred at many of the outfall sites resulting in the production of highly objectionable odours. Unsightly growths of algae are a common occurrence along the waterfront area. Floating debris is commonly present at the outfalls and frequently accumulates along the shoreline. The transparency of harbour water is generally very low and plumes of various colours can be seen periodically at many locations.

The problem is not just one of aesthetics. Fecal coliform bacteria concentrations are considerably elevated throughout the Inlet area. Nutrient enrichment and subsequent oxygen depression have been identified as a potential concern, particularly within the deep waters of Bedford Basin. Elevated concentrations of trace materials (metals and manmade compounds such as Lead, DDT, etc.) have been reported in the nearshore sediments of the Inner Harbour.

The consequences of allowing large quantities of raw sewage to be discharged to the waters of Halifax Harbour on a continuing basis are considered to be very serious. There is a concern for the health of the Inlet's sensitive marine ecosystem particularly in the immediate vicinity of existing outfalls. Failure to reduce pollutant stresses on the ecosystem before they multiply with increasing population growth could result in long term damage.

Those who live and work in the Metropolitan Area are forced to cope with the stigma of having to rely on a sewage disposal system which is reminiscent of bygone eras. And while the resultant impact on the average citizen's sense of pride in ones surroundings may be difficult to measure, the impacts of raw sewage discharge on other activities within the Region are less so. For example, there is strong evidence to suggest that the continued practice of discharging large quantities of raw sewage may result in curtailment of the use of Inlet waters and beaches for water based recreation activities within the foreseeable future.

The region's commercial fishery has also been affected by the lack of wastewater treatment. Futhermore, tourism industry development opportunities have not been fully exploited because of the present Harbour condition. Indeed the pollution of Halifax Harbour and its environs can only have a continuing detrimental impact on the Regions $130 million per year tourism industry. The commercial development potential of the Metropolitan area in general, and the waterfront area in particular is, to a degree, being jeopardized.

2. MAPC STUDY

The final phase of a three-year, $400,000 Inlet pollution control study, was completed in May, 1987. The Study was initiated by the Metrolpolitan Area Planning Commission (MAPC) and managed by a Pollution Control Advisory Group comprising representatives of the four Metropolitan Area Municipalities, the Provincial Departments of Environment, Health and Municipal Affairs and Environment Canada. The identification of what can and must be done to alleviate the harbour pollution problem was the central objective of the Study. The study team developed and evaluated a number of sewage treatment strategies for the area, including construction of a single treatment facility as well as several multiple plant options.

The study concluded that the option involving construction of a single regional treatment facility located at Sandwich Point on the western shore of the Outer Harbour (See Attachment 1) offers the greatest potential for improvement in overall Inlet water quality and hence, maximization of the Harbour's value as a recreation resource and economic development tool. The study demonstrated that, while the initial capital outlay required for this option ($156 million) in 1987 $ would be somewhat higher than other strategies, life cycle costs (capital and operating costs discounted to present day values) would be comparable to all other options considered.

3. THE PROPOSAL

Following is a proposal for an overall Harbour Cleanup Program based on the single regional treatment facility proposal illustrated in Figure 1.

3.1 PROJECT OBJECTIVE

The objective of this Cleanup Program is the elimination, by means of primary treatment, of all raw sewage discharges into the waters of Halifax Inlet within six years.

3.2 PROJECT DESCRIPTION

This improvement program will result in the conveyance of wastewater from all of the 40 or so existing raw sewage outfalls to a single treatment location and will be accomplished by means of (See Attachment 1):

a) Construction of a piped interceptor system and pumping facilities to convey sewage from South Dartmouth to the beginning of an interceptor tunnel at Dartmouth Cove.

b) Construction of an interceptor tunnel along the Dartmouth waterfront from Dartmouth Cove to Tufts Cove.

c) Construction of a tunnel under the Narrows from Tufts Cove to a point near the intersection of Duffus and Barrington Streets.

d) Construction of an interceptor tunnel from Duffus Street along the Halifax waterfront, across the Northwest Arm and through Purcells Cove to Sandwich Point.

e) Construction of a pumping station and forcemain to convey sewage flows from the existing sewer outfall at Herring Cove to Sandwich Point.

f) Construction of a sewage pumping station and 40 million gallon per day capacity primary sewage treatment plant at Sandwich Point.

g) the methods used in this project for treating the sewage are:

1. Sewage Pumping Stations at South Dartmouth, Herring Cove, and Sandwich Point.

2. Preliminary Treatment to improve aesthetic conditions by removing gross solids and floatable materials, using:
   - mechanically raked bar screen
   - aerated grit chamber

3. Primary Treatment:

   - clarification to settle and remove sludge
   - effluent disinfection with chlorine
   - sludge treatment:
     - anaerobic digestion
     - mechanical dewatering
     - disposal

4. Sludge Disposal: options being studied:
   - landfill
   - landfarming
   - forest application
   - conversion to oil
   - ocean disposal
   - incineration
   - fertilizer component

5. Outfall Pipe with multiple point diffuser in deep water.

These treatment methods will reduce pollutant levels compared to raw sewage as follows:

Suspended Solids	55%
Biochemical Oxygen Demand	30%
Nitrogen	10%
Phosphorus	5%
Total Coliforms	95%
Fecal Coliforms	95%
Trace Metals	25-50%

The present Eastern Passage and Mill Cove Sewage Treatment Plants will continue to operate.

3.3 PROJECT CAPITAL COSTS

Following is a summary of the capital costs associated with this project:

PROJECT COMPONENT	ESTIMATED CAPITAL COST (1987 DOLLARS)
1. Pipework and Tunnels	$100,400,000
2. Pumping Facilities	7,500,000
3. Sewage Treatment Plant	41,700,000
4. Land Acquisition and STP Site Development	6,400,000
TOTAL	$156,000,000

It is proposed that implementation of the recommended improvement program take place over a six-year period beginning in 1988 and extending to 1994.

4. EXPECTED BENEFITS

The environment and the economy of the Halifax-Dartmouth Metropolitan Area will benefit from the proposed Harbour Cleanup Program.

4.1 ENVIRONMENTAL BENEFITS

Through the elimination of all raw sewage discharges into the waters of Halifax Inlet, this program will have the following environmental impacts:

a) significant improvement in aesthetics within the Inlet and, in particular, along the surrounding shoreline.

b) reduction in fecal coliform concentrations thereby significantly alleviating health risks and enhancing the Inlet's value as a recreation resource (particularly body contact recreation).

c) improvement in dissolved oxygen levels and elimination of sludge deposition in the vicinity of outfalls.

d) reduction of up to 50 percent in the trace materials loading of Halifax Inlet waters thereby improving seafloor conditions within the Inner Harbour.

e) reduction in nutrient loading within the Inner Harbour and, perhaps more importantly, within Bedford Basin.

f) improvement in Nova Scotia's sewage treatment performance to a level equivalent to the present national average (i.e. 60 percent of those served by central sewers would also be served by sewage treatment plants).

g) reduction in nutrients and trace materials levels, together with effluent plume dispersion, will reduce fouling of fishing nets and the life of the commercial fishery will be extended.

In general, this program will make Halifax a better place to live and work and engender a new sense of community pride on the part of those so doing.

4.2 ECONOMIC BENEFITS

A healthy environment is essential to a sound healthy economy. The two are inextricably intertwined. History has shown all too clearly that when an environment is violated, in the short term, economic activity can be restricted, in the long term. All too often it is the environmental benefits of a project such as this that make the headlines. It is rare when the economics of such successes are featured.

Economic benefits can be broadly classified as short term (those benefits derived during the period of project construction) and long term (those which will be perpetuated into the future).

The primary short term economic benefit of this project is employment creation. Up to 1600 man years of direct employment will be generated over the six-year life of the project. In addition, the project is expected to generate as many as 3500 man years in spin off employment activity throughout the Province. Tax revenues totalling $28.7 million are expected to accrue to the Federal ($11.7 million), Provincial ($12.7 million) and Municipal ($4.3 million) governments. Futhermore, it is expected that benefits in the form of reduced unemployment insurance and social assistance costs will be realized by all three levels of government as a result of increased employment activity within the construction industry.

In the longer term, the cleanup of Halifax Harbour will make the Metropolitan Area generally more attractive to both out-of-province visitors and investors. Specific long term economic benefits will include the following:

a) preservation and enhancement of the Region's tourism industry through strong promotion of the Harbour resource thereby resulting in increased employment activity.

b) increased commercial and residential development activity within the Region generally (more so, perhaps, in the watefront area), along with resultant employment generation activity.

c) continued viability and expansion of the Region's commercial inshore fishing industry.

In general, this project will provide an environment/development balance which is sustainable in the long term and which will allow the Harbour to contribute to the Region's economy to its full potential.

5. PROPOSED FUNDING ARRANGEMENT

The Province has negotiated and signed on 25 July, 1988, a cost-sharing agreement with the Federal government for this six-year project. The Federal government will cover 37½% of the cost, the Province 37½%, and the cities of Halifax and Dartmouth and Halifax County will cost-share the remaining 25%. The total overall cost of the project, allowing for inflation over the six-year period will be approximately $196 million.

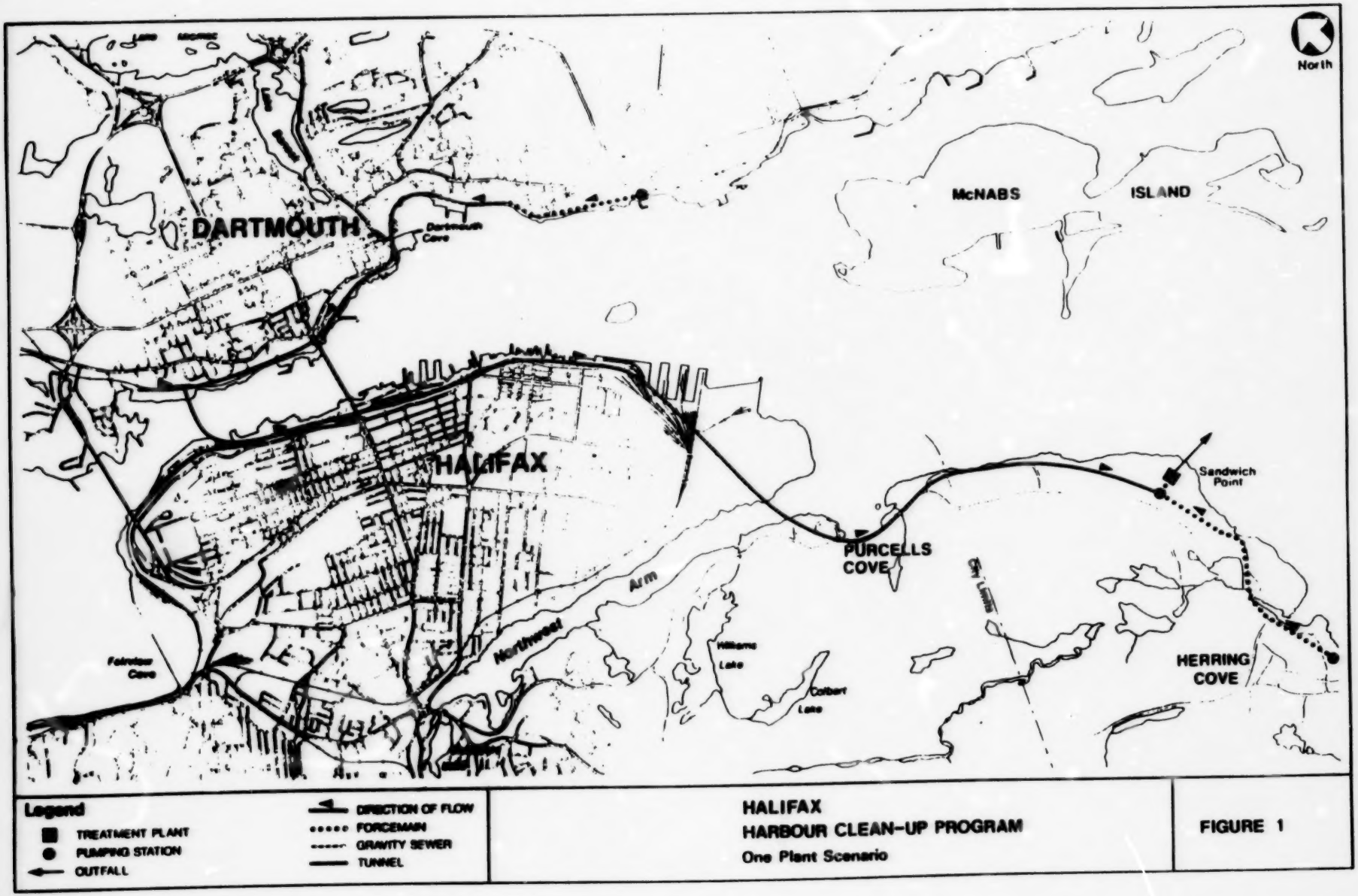
6. ENVIRONMENTAL REVIEW

The Minister of the Nova Scotia Department of the Environment requested that the Environmental Control Council set up a review committee to undertake an independent assessment of the project. The mandate of this review committee is to review all existing relevant information, interview persons knowledgeable of the project and the receiving environment, obtain and incorporate the concerns of individuals and groups potentially affected by the proposed plant and effluent discharge, and prepare a final report on the project impact. The report should consider the marine ecosystem impacts, commercial fishery related impacts, unknowns remaining, and if appropriate, recommendations for mitigation of adverse impacts identified.

The review committee will be receiving submissions, written or oral, during the month of November. Parties wishing to make appointments must contact the Environmental Control Council by October 21, 1988, as indicated in the attached notice (Attachment 2).

The purpose of the meetings is to hear the concerns of interested individuals, groups and organization's. Those persons wishing additional information can view such at the Nova Scotia Department of the Environment Library at 5151 Terminal Road, Halifax. A suggested reading list is attached. (Attachment 3)

Nova Scotia Department of the Environment
and Nova Scotia Department of Municipal Affairs
October 1988



HALIFAX
HARBOUR CLEAN-UP PROGRAM
One Plant Scenario

FIGURE 1

HALIFAX HARBOUR REVIEW COMMITTEE CALL FOR SUBMISSIONS

The Nova Scotia Environmental Control Council has established a Review Committee to study the possible location of a single regional sewage treatment plant at Sandwich Point. Primary emphasis of the review will be on the commercial fishery. Written or oral submissions will be accepted by October 21, 1988.

Send written submissions to:

The Halifax Harbour Cleanup Review Committee
Nova Scotia Environment Control Council
P.O. Box 2107
Halifax, Nova Scotia
B3J 3B7

Appointments for oral submissions and requests for information can be made by calling:

424-5300 (ext. 146)

The Committee's report will be submitted to the Environmental Control Council, which in turn will report to the Minister of the Environment.

APPENDIX F

INFORMATION MEETINGS

HALIFAX HARBOUR CLEANUP REVIEW COMMITTEE

INFORMATION MEETINGS

Wednesday, 2 November 1988: Keddy's Motor Inn, Halifax, N.S.

Thursday, 3 November 1988: Keddy's Motor Inn, Halifax, N.S.

Wednesday, 16 November 1988: St. Paul's Parish Hall, Herring Cove, N.S.

Thursday, 17 November 1988: Hotel Nova Scotian, Halifax, N.S.

APPENDIX G

ORAL AND WRITTEN PRESENTATIONS RECEIVED

HALIFAX HARBOUR CLEANUP REVIEW COMMITTEE

SUBMISSIONS TO REVIEW COMMITTEE

ORAL SUBMISSIONS:

2 November 1988: Halifax

OceanChem Group, Dr. Scott MacKnight
Dartmouth Chamber of Commerce, Dr. Scott MacKnight
Randy Ball, Councillor, District 5
Alan O'Brien, Halifax
Alan Ruffman, Ferguson's Cove
Joseph Tremble, Herring Cove

3 November 1988: Halifax

Peter Pelham, Herring Cove
Robert Power, Herring Cove
Municipality of Halifax County (L. Lichter, Warden)
Northwest Arm Heritage Association (Graham Read)
Herring Cove Ratepayers Association (Rob Belliveau)

16 November 1988: Herring Cove

Herring Cove Ratepayers Association (Rob Belliveau)

Robert Gordon, Herring Cove	Linda Christian-Ruffman
Randy Ball, Herring Cove	E. Dempsey
Colin Baker (ex-Councillor)	N. Steele
Fred Martin, Herring Cove	F. Gallagher
Gary Tomlin	Martin Willison
----- Palmer	Barbara Lapierre
Ed Hanrahan	Dr. D.R. Campbell
Mark King	John Zuk
Jim Christian	Cheryl Landry
Peter Pelham	Aileen Murphy
Kevin Burke	Fred Holtz
Joe Tremble	N. King
D. Flemming	A.M. March
D. Dempsey	Ray Jollimore

17 November 1988: Halifax

Ecology Action Centre (Cristina Pekarik)
ASA Consulting Ltd. (S.E. Hurlbut)
Bedford Institute of Oceanography (D. Buckley, B. Hargrave, G. Seibert)
David VanderZwaag, Ferguson's Cove

HALIFAX HARBOUR CLEANUP REVIEW COMMITTEE

SUBMISSIONS TO REVIEW COMMITTEE

WRITTEN SUBMISSIONS:

1. OceanChem Group
2. Mr. Randy Ball, Councillor
3. Municipality of Halifax County
4. Edward E. Dempsey
5. Northwest Arm Heritage Association
6. Dr. D.R. Campbell
7. Sisters of Charity
8. Ecology Action Centre
9. Herring Cove Ratepayers Association
10. ASA Consulting Ltd. (S.E. Hurlbut)
11. Bedford Institute of Oceanography (Dale Buckley)